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AUTHOR West, Jerry; And Others
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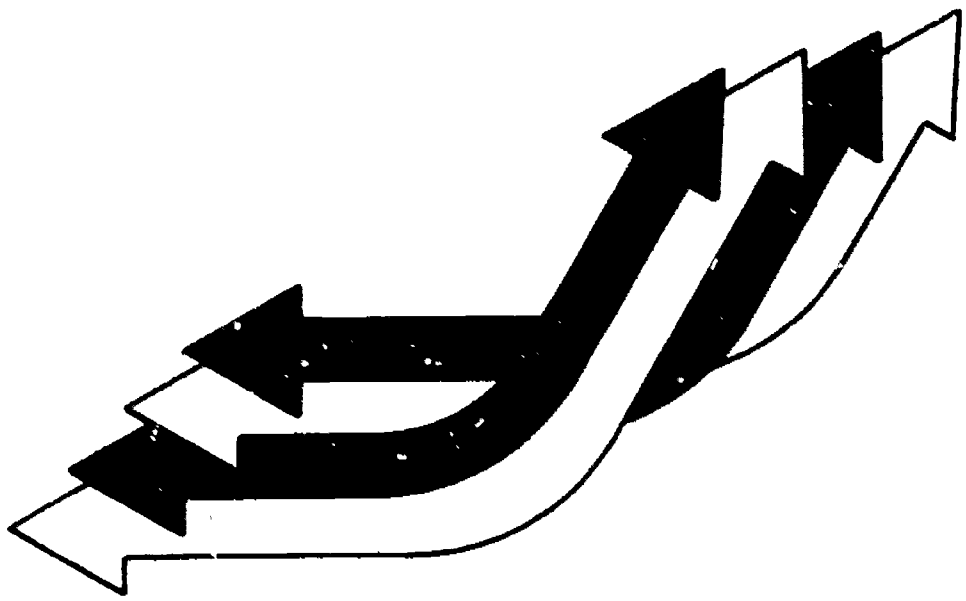
ABSTRACT

Responses to the problems of secondary school education must be predicated on reliable information on student participation in mathematics, science, computer science, vocational education, and general education. This analysis summarized 1981-1982 High School and Beyond student transcript data to identify course-taking patterns relative to each of the above subject areas. Moreover, responses to the First Follow-up Survey were used to identify characteristics of students exhibiting various course-taking patterns. Four distinct course-taking patterns were identified for science and mathematics students, and four others were identified for vocational education students. Student characteristics considered were socio-demographic attributes, school performance and experiences, and postsecondary plans and aspirations. Findings reported include the following: (1) less than 10 percent of the students had concentrated in mathematics or science in high school; (2) course-taking patterns in all subject areas were strongly related to socioeconomic status and to type of school attended; (3) grade averages and cognitive test scores differed significantly across the course-taking patterns of each subject area; and (4) in general, the immediate post-graduation plans of students were not related to course-taking patterns. (MNS)

High School and Beyond

a national longitudinal study for the 1980's

An Analysis of Course-Taking Patterns in Secondary Schools as Related to Student Characteristics



National Center for Education Statistics

An Analysis of Course-Taking Patterns in Secondary Schools as Related to Student Characteristics

Evaluation Technologies Incorporated

Jerry West
Wendy Miller
Louis Diodato

George H. Brown
Project Officer
National Center for Education Statistics

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EXECUTIVE SUMMARY

Over the last 20 years, the United States has witnessed a widespread decline in the quality of education. This decline has been especially pronounced with respect to mathematics and science, as evidenced by lowered enrollments and achievement scores, a diminishing teacher pool, and increased numbers of students on a general education track. This situation was brought to the forefront of public attention by the National Commission on Excellence in Education's report, A Nation at Risk: The Imperative for Education Reform. A central focus of the report was on the need to redress the decline in mathematics and science education and to prepare students to use emerging new technologies, such as the computer, so they may compete effectively in today's society.

Much of the public discussion and debate as to how to resolve the problems facing education in the United States has centered on how to impart basic skills to students and what should constitute a secondary school curriculum. Commissions and panels have set forth recommendations which would require a shift in emphasis to more traditional academic pursuits (i.e., mathematics, science, English, etc.). The role of non-academic programs, such as vocational education and general education, in responding to the problems in secondary education has yet to be determined.

Responses to the problems of secondary school education must be predicated on current and reliable information on student participation in mathematics, science, computer science, vocational education, and general education. Specifically, information is needed on the various course-taking patterns exhibited by students in each of these areas and the characteristics of these students. Taken together, this information may provide a base for policy decisions concerning the future direction of secondary school curricula.

The analysis summarized in this report used 1981-82 High School and Beyond (HS&B) student transcript data to identify course-taking patterns relative

to each of the above-mentioned subject areas. Moreover, the responses of schools and students to the HS&B First Follow-up Survey were used to identify the characteristics of students exhibiting the various mathematics, science, computer science, vocational education, and general education course-taking patterns. Some representative findings of the analysis follow.

Course-Taking Patterns

Student course-taking patterns were defined by the number of credits students earned in various types and levels of courses within each of the subject areas of interest. The patterns within each subject area are on a continuum, ranging from no or limited participation to intense participation. For mathematics and science, four distinct patterns were identified: (1) concentrators; (2) 4-year college bound students; (3) general mathematics (science) students; and (4) non-participants or limited participants. For vocational education, students were classified as either (1) concentrators; (2) limited concentrators; (3) samplers; or (4) non-participants. Because so few students had earned computer science credit, only two patterns were distinguishable, participants and non-participants. Participation in a general education program 1/ was measured by students' self-reported descriptions of their high school program.

- A minority of students had concentrated in mathematics (8.6 percent) or science (9.3 percent) in high school, while about one-half of all students exhibited a general level of participation (i.e., were classified as general mathematics or general science students). Nearly one in every 20 students had earned less than one mathematics credit, and one in every six had earned less than one science credit during their high school careers.

- Overall, participation in mathematics and science were strongly related. For example, a majority of mathematics concentrators were

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1/ For a definition of "general education program" as used in this report see page 13 and 26.

either science concentrators (46 percent) or 4-year college bound science students (43 percent). Nearly all science concentrators were either mathematics concentrators or 4-year college bound mathematics students (96 percent).

- About one-half of the students had exhibited either a strong vocational focus (concentrators) or a vocational interest (limited concentrators). Less than five percent of the students had earned no vocational education credit.

- Participation in vocational education was negatively related to participation in mathematics and science. However, advanced level participation in mathematics and science did not preclude students from seeking vocational training, nor did intense participation in vocational education preclude students from earning credit in advanced level mathematics and science courses.

- Given that as late as 1981-82 only 55 percent of all schools in the nation made computer science instruction available to students, it is not surprising that only 13 percent of all students had earned some computer science credit.

- Participation in computer science was commonly related to more intense participation in mathematics. A similar pattern was found with respect to science.

- Over one-third of the students defined their high school program as general. These students earned fewer credits in the humanities, mathematics, and science than did those in academic and vocational programs.

Characteristics of Students Exhibiting Various Course-Taking Patterns

Course-taking patterns were examined with respect to a number of student characteristics. These characteristics fall into three categories: (1) socio-demographic attributes; (2) school performance and experiences; and (3) postsecondary plans and aspirations.

Socio-demographic Attributes

- Course-taking patterns in all subject areas were strongly related to socioeconomic status (SES). In particular, high SES students were more likely to participate at a more intense level in mathematics, science, and computer science. More intense participation in vocational education and general education was more frequently associated with low SES.

- A student's race/ethnicity was unrelated to participation in vocational education. White students exhibited more intense participation in mathematics, science, and computer science. A larger percentage of Hispanic/other students had participated in a general education program than had students from other racial/ethnic groups.

- A student's sex was related to participation in science, with males participating at more intense levels. In addition, more males had participated in a general education program. No major differences were noted with respect to male and female participation in mathematics and computer science. For vocational education, few differences were found; however, a higher percentage of females were concentrators.

- The type of school that students attended was strongly related to course-taking patterns in all of the subject areas. Specifically, concentration in mathematics and science was more typically associated with private school attendance whereas a general level of participation in these subjects was more commonly found among public school students. Because few private schools had offered many of the courses encompassed in a vocational education curriculum, public school students were more likely to have a strong vocational focus or interest. Public school students were also more likely to have taken part in a general education program. Students who had attended other (i.e., non-Catholic) private schools were less likely to have participated in computer science.

School Performance and Experiences

- Grade averages and cognitive test scores differed significantly across the course-taking patterns of each subject area. Students who had participated at a more intense level in mathematics, science, computer science earned higher overall grade averages and scored higher on tests designed to measure their vocabulary, verbal, and mathematics abilities. The reverse pattern held with respect to vocational education and general education participation.

- Students who had participated more intensely in mathematics and science and, to a lesser degree, those who had participated in computer science were more likely than other students to have taken part in certain extra-curricular activities. For example, these students were more likely to have been involved in the production of the school newspaper/yearbook, been members of honorary and service clubs, and participated in varsity and other athletics. On the other hand, students who had concentrated in vocational education partici- pated to a lesser extent in many of these activities, as did general education students.

Postsecondary Plans and Aspirations

- In general, the immediate post-graduation plans of students were not related to course-taking patterns. The largest differences that were found occurred with respect to attendance at a 4-year college or university and full-time employment. Students who had participated more intensely in mathematics, science, or computer science were more likely to indicate that the majority of their time would be spent pursuing study at a 4-year college or university the first year after high school graduation. A smaller percentage of these same students indicated that they planned to work full-time the year after graduation. Not surprisingly, the short-term plans of vocational education concentrators and limited concentrators and of general education students were more likely to include full-time employment.

- For the most part, the educational expectations of students were consistent with their high school course-taking patterns. That is, a higher percentage of students who had participated more intensely in mathematics, science, or computer science expected to attain at least a 4- or 5-year college degree. On the other hand, the percentage of students who expected their formal education to end with high school or to include vocational, trade, or business school attendance was higher among those students who had shown a strong vocational interest or focus than among other students. A similar pattern of educational expectations was found with respect to participation in a general education program.

- With few exceptions, students shared similar job aspirations regardless of their course-taking patterns in each of the subject areas of interest. Many students aspired to a job in a professional capacity by age 30; however, the percentage of students with this aspiration was higher among mathematics and science concentrators/ 4-year college bound students and computer science participants than among those who had participated less intensely in these subjects. Vocational education concentrators were more likely than others to indicate that they aspired to a clerical or craftsman occupation. Overall, the job aspirations of general education students resembled those of students in other programs; however, a smaller percentage of general education students expected to be in a professional occupation at age 30.

- The intended fields of study of college bound students did not differ markedly by course-taking pattern. Some differences were detected, however. Mathematics and science concentrators were more likely to study architecture and engineering and biological and physical sciences and were less likely to study business, art, or music. Science concentrators were also more likely than other students to plan to enter preprofessional programs. As expected, computer science participants were three times as likely as other students to plan to study computer and information sciences. General education students were less likely than others to plan to study architecture and engineering or enter a preprofessional program and were more likely to study art and music. As

expected, a higher percentage of vocational education concentrators expressed plans to study business or pursue vocational/technical studies in college.

- The vast majority of students did not plan on attending a trade or vocational school. Nevertheless, vocational education concentrators were more likely to do so than were students in the other vocational education patterns. The field of study most often cited by these students was secretarial, stenographic, typing, or other office work. This was followed by computer programming or computer operations and auto mechanics. Computer programming or computer operations was identified by the largest percentage of students in each of the other course-taking patterns as the field they would most likely study at a trade or vocational school.

CHAPTER 1

INTRODUCTION

A well-documented problem facing education in the United States today is the critical need to impart basic skills in mathematics and science to its students. Moreover, with the increasing role computers are playing in all facets of American life, another problem facing education is that of deciding how best to prepare students for using this technology. Panels, commissions, and policy-makers at the highest levels have studied these problems and have put forth specific proposals for redressing them. The majority of these proposals shift curriculum emphasis and class hours away from such programs as general education and vocational education to required courses in mathematics, science, and computer science. Advocates of vocational education have argued that such proposals have traditionally overlooked the role of their field in responding to these problems.

The analysis summarized in this report is intended to provide educators, policymakers, and the general public with information on the current status of mathematics, science, vocational education, computer science, and general education in the secondary schools of the United States. In particular, this analysis provides information on students' course-taking patterns in these subject areas as they relate to student characteristics. Data collected by the National Center for Education Statistics were analyzed to address questions concerning these secondary school programs. The answers provided to these questions may be used as input into policy decisions concerning the future directions of mathematics, science, vocational education, computer science, and general education in our nation's schools.

1.1 The Decline in Mathematics and Science Education

Over the last two decades, mathematics, and science education have experienced three essential problems: declining enrollments, declining achievement

scores, and a diminishing teacher pool. Enrollment in traditional mathematics courses dropped sharply between 1964 and 1981. The percentage of high school students enrolled in algebra 1 declined from 76 to 64 percent, while enrollment in geometry dropped from 51 to 44 percent, and algebra 2 from 35 to 31 percent. Enrollments in science courses such as biology (80 to 77 percent), chemistry (34 to 32 percent), and general science (61 to 37 percent) experienced similar declines over this period. 1/

Interrelated with declining enrollments in mathematics and science is the decline in student achievement scores in these areas. The National Science Board reported that between 1973 and 1982 the mean achievement scores of 17 year-olds declined 3.2 percent in mathematics. Similarly, between 1970 and 1983 mean science achievement scores declined 6.7 percent. Regarding the decline in the sciences, Stephen Graubard, editor of Daedalus, dismally concluded, "scientific knowledge and understanding, by any reasonable standard, is so uncommon among Americans of all ages and races today that it is no exaggeration to speak of mass illiteracy in the sciences." 2/

Compounding the problem of declining enrollments and achievement scores is the diminishing mathematics teacher pool. Max Sobel, past president of the National Council of Teachers of Mathematics, noted:

> Since 1972 there has been a 77 percent decline in the number of secondary level mathematics teachers prepared by schools of education nationwide. As a result, over 50 percent of the newly employed mathematics teachers in some states are considered to

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1/ Clifford Adelman, "Devaluation, Diffusion and the College Connection: A Study of High School Transcripts, 1964-81," Washington, D.C. National Institute of Education, March 1983 in Educating Americans for the 21st Century by the National Science Board Commission on Precollege Education in Mathematics, Science and Technology, September, 1983, p. 1.

2/ Stephen Graubard, ed. "Nothing to Fear, Much to Do," Daedalus, Spring, 1983, p. 237.

be unqualified to teach mathematics, but continue to be employed on an emergency basis because fully certified teachers are not available. 3/

The reduced science teacher pool is also critical. Between 1970 and 1980 the production of science teachers by schools of education dropped by 64 percent. 4/

Another factor that is viewed as a major contributor to the decline in mathematics, science, and other academic courses in U.S. secondary schools is the increased number of students on a general education track. 5/ Between the late 1960s and the late 1970s, the percentage of students in a general track increased from 12 percent to roughly 43 percent.

The increased freedom to select courses tailored to the needs and interests of the individual student resulted in both a reduction in high school graduation requirements and students receiving a much narrower range of high school class experiences. 6/ Thus, as a philosophy of secondary education, general education has not lived up to its intentions, and its overall goals are ambiguous. 7/

3/ Max A. Sobel, "The Crisis in Mathematics Education," Educational Horizons, Winter.

4/ Susan Walton, "A Generation Lags Behind as Science Advanced," Education Week, July 27, 1983, p. 2.

5/ Clifford Adelman, "Devaluation, Diffusion and the College Connection: A Study of High School Transcripts, 1964-81."

6/ D. Offermann, "Designing a General Education Curriculum for Today's High School Student," Educational Leadership, March, 1984.

7/ R. Brandt (ed.), "The Fate of Craft Boutique," Educational Leadership, March, 1984.

According to Adelman, the education experience of the general track student is quite different from that of the academic or vocational track student. The general track student spends more time in personal service and development courses, home economic courses, and arts and crafts courses. The academic experience of the general track student is characterized by participation in remedial and generalized courses (e.g., general sciences, general social studies, and general mathematics). Study within a subject area (e.g., vocational education), while it may be intense, is at the same time diverse.

1.2 Solutions to the Decline in Mathematics and Science and Their Impacts on Vocational Education

Many of the proposed solutions to the problems confronting mathematics and science education require a restructuring of curriculum emphasis. Students would be required to take more courses in and devote more of their class hours to mathematics and science. The Paideia Proposal (Adler, et al.) would eliminate "all specialized training for particular jobs" from the secondary school curriculum in order to make time for the essentials of "basic schooling." 8/ A plan of action, prepared by the National Science Board, for improving mathematics, science and technology education for all American elementary and secondary students recommends significant increases in the number of required mathematics and science courses. In the language of the report,

> All secondary school students should be required to take at least three years of high school mathematics including one year of algebra . . . (and) at least three years of science and technology, including one semester of computer science prior to high school graduation. 9/

8/ Mortimer J. Adler et al., The Paideia Proposal -- An Educational Manifesto (New York: Macmillan Publishing Co., 1982), p. 35.

9/ National Science Board Commission on Precollege Education in Mathematics, Science and Technology, Educating Americans for the 21st Century (Washington, D.C., 1983), p. 40.

The recommendations of the National Commission on Excellence in Education strongly emphasize a return to basics, or as the Commission phrases it, the "new basics." In the areas of mathematics and science, all students would be required to take, "at a minimum," three years of mathematics, three years of science, and one-half year of computer science. 10/ While the Commission urges that high school curricula "also provide students with programs requiring rigorous effort in subjects that advance students' personal, educational, and occupational goals." 11/ it does not acknowledge the central problem of the limited number of hours in the school day or the opportunities to acquire basic technological skills already available to students in non-academic curricula.

Gene Bottoms, Executive Director of the American Vocational Association, takes exception to the proposal contained in the Commission on Excellence report and other similar reports. He notes:

> [They] focus narrowly on the academic curriculum in the high school. Both reports refer repeatedly to the goal of excellence for all programs and all students, but the recommendations fail to live up to this intention. In fact, four of the six specific charges to the Commission on Excellence dealt with preparation for college, college admissions, and success in college. No mention was made of preparation for work. 12/

Bottoms goes on to say, "The two prestigious panels did not even consider the potential of non-academic curriculums to contribute to the 'new basics' or to alleviate scientific and technological backwardness." 13/

10/ The National Commission on Excellence in Education, A Nation at Risk: The Imperative for Educational Reform (Washington, D.C., 1983), p. 24.

11/ A Nation at Risk, p. 26.

12/ Gene Bottoms, AVA Executive Director, "Voc Ed Belongs on the National Agenda for Excellence," VocEd, October 1983, p.8.

13/ Bottoms, p. 8.

The problems facing mathematics and science education must be resolved if our young people are going to compete effectively in an ever-changing technological world. However, there is much debate concerning the best way to accomplish this goal. Some argue that solving the problems of mathematics and science by undermining the success of vocational education in preparing students for entry into the labor force is not in the best interest of the nation or its young.

Before we adopt solutions to the problems confronting education in mathematics and science, we need to understand better the status of mathematics and science in the nation's secondary schools. Moreover, we need more information on those areas -- such as vocational education, general education, and the arts, and the humanities -- that would be affected by attempts to remedy the mathematics and science deficiencies of high school students. In particular, information is needed on: (1) the types of courses currently being taught in mathematics, science, and vocational education, and computer science; (2) the current enrollments in these courses, (3) the characteristics of schools that offer different numbers and types of courses in these areas and have differential student participation rates in theses courses; (4) student course-taking patterns in mathematics, science, and vocational education, computer science, and general education; and (5) the characteristics of students who participate to varying degrees in these programs.

1.3 Computer Science Education

It is generally recognized that there is a shortage of computer science instruction in our nation's schools. It is equally recognized that, at a minimum, today's students need to become acquainted with the computer and its uses if they are to compete effectively in the job market and succeed in postsecondary education. Furthermore, schools are experiencing the value of the computer as a learning tool which permits students to explore subject areas and investigate concepts through simulations and games.

Traditionally, computer studies in education have been classified into two main groupings -- computer science and business data processing. Computer

science was traditionally tied to mathematics while business data processing, as its name implies, was linked to the study of business. Recently, a third classification of computer studies has emerged which focuses on learning about computers. Computer literacy courses provide students with the opportunity to learn what a computer is, how it works, and what it can and cannot do.

As indicated earlier, many of the panels and commissions that have studied the status of contemporary education have recommended that computer science instruction be a part of all students' educational experience. There is, however, much discussion concerning the best way to achieve this goal. Often missing from this discussion is current information on the level of computer science instruction in schools, enrollments in these courses, and the characteristics of schools with differential offerings and students participation in this type of program. 14/

1.4 An Analysis of Student Participation in Mathematics, Science, Vocational Education, Computer Science, and General Education

Recognizing the need for detailed information on the status of mathematics, science, vocational education, computer science and general education in secondary education, and the ability of certain data collected by the National Center for Education Statistics (NCES) to help meet this need, the NCES contracted with Evaluation Technologies Incorporated (ETI) to design

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14/ Throughout this report, the term computer science is used to refer to the overall study of computers, including courses traditionally classified as computer science, business data processing, and computer literacy. An alternative term, which some might prefer, would be computer studies.

and conduct two analyses as they relate to these subject areas. The two analyses constitue two seperate studies:

(1) A study of offerings and enrollments as they relate to school characteristics; 15/ and

(2) A study of student course-taking behavior as it relates to student characteristics.

The general objectives of the first study were to:

- Identify current mathematics, science, vocational education, and computer science course offerings and enrollments in the secondary schools in the United States; and

- Identify those school characteristics that are associated with course offerings and enrollments in mathematics, science, vocational education, and computer science.

The goals of the second study are to:

- Define the course-taking patterns of mathematics, science, vocational education, computer science, and general education students in secondary schools;

- Determine students' school experiences and extra-curricular experiences that are related to their course-taking behavior in these areas; and

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15/ Evaluation Technologies Incorporated, An Analysis of Course Offerings and Enrollments as Related to School Characteristics, Washington, D.C.: National Center for Education Statistics, October 2, 1984.

- Assess the impact of having taken mathematics, science, vocational education, computer science, and general education courses on student aspirations and achievements.

1.5 Data Sources

As part of its longitudinal studies program, NCES sponsors the High School and Beyond (HS&B) study. The HS&B Base Year Survey and First Follow-Up Survey provide detailed information on the school experiences, attitudes, activities, future plans, personal motivations, and selected background characteristics of a nationally representative sample of 1982 graduating seniors (sophomore class of 1980). In addition, transcript data collected during the First Follow-Up Survey make it possible to identify the course-taking behavior of students in different curriculum areas.

1.6 Report Organization

The remainder of this report is organized into seven chapters and a technical appendix. Chapter 2, entitled Key Study Definitions, presents both at the conceptual and operational level, definitions of mathematics, science, vocational education, computer science, and general education as developed by advisory panels of subject-matter experts. This chapter also describes the course-taking patterns of secondary school students which are the focus of the analysis. Chapter 3 presents an overview of study findings pertaining to course-taking patterns in these subjects. The mathematics, science, vocational education and computer science course-taking patterns as related to student characteristics are summarized in Chapter 4 through 7, respectively. Research findings pertaining to the characteristics of general education students are presented in Chapter 8. The technical appendix presents brief descriptions of the sample designs, data sources, data adjustments, and procedures for calculating standard errors. It also contain a complete list of the courses which were encompassed under various mathematics, science, vocational education, and computer science instructional programs.

CHAPTER 2

KEY STUDY DEFINITIONS

When designing the analysis of student course-taking patterns in mathematics, science, vocational education, computer science, and general education, it was necessary to establish conceptual and operational definitions of each area. These definitions were required for two reasons: (1) for the analysis to produce meaningful and policy-relevant findings, course-taking patterns in all curriculum areas had to be uniquely described within the context of secondary education, and (2) the quantitative nature of the analysis required that key concepts be operationally defined in terms of the available survey data.

The NCES determined that subject-area specialists were needed to identify the common and unique elements of mathematics, science, vocational education, computer science, and general education at the secondary level and to advise in the operationalization of course-taking patterns in these areas. Specialists were selected from among national, state, and local leaders in secondary and postsecondary education and in educational policy development.

The subject-area specialists and ETI project staff convened to: (1) develop both abstract and operational definitions of mathematics, science, vocational education, and computer science; (2) identify high school courses which should be flagged as offerings of these types; (3) identify course-taking patterns for study; and (4) develop a set of research questions framed in the HS&B survey data. Two sessions were held, one to consider mathematics, science, and computer science and one to consider vocational education.

The general education specialists did not convene. Rather, ETI project staff held conversations with each of these persons individually. During these conversations, they discussed: (1) the definition of general education; (2) the appropriateness of identifying course codes to define a

general education curriculum; and (3) the development of research questions pertaining to general education.

These subject-matter specialists provided either a conceptual definition of the relevant subject area accompanied by a list of course codes from the Classification of Secondary School Courses (CSSC) organized to represent this definition, or the codes which implied a clear definition. 16/ These definitions are presented in the following sections. The CSSC codes which were used to define secondary school study in each area are included as part of the technical appendix to this report.

2.1 Mathematics

Mathematics is the group of subjects that deals with quantities, magnitudes, forms, and their relationships by the use and manipulation of numbers and symbols. For purposes of the analysis, mathematics courses were organized into categories on the basis of their intended outcome and the type of students that they served. The study of mathematics at the secondary school level includes the following types of coursework:

- o College Preparatory Courses for Gifted-Talented Students (e.g., linear algebra, calculus, and advanced placement calculus)

- o College Preparatory Courses for Mathematics Concentrators (e.g., analytic geometry, algebra and trigonometry, and probability and statistics)

- o College Preparatory Courses for 4-Year College Bound Students (e.g., algebra 1, 2, and 3, geometry, and trigonometry)

16/ Evaluation Technologies Incorporated, A Classification of Secondary School Courses, Washington, D.C.: National Center for Education Statistics, 1982.

- General Mathematics (e.g., general mathematics 1 and 2)

- Vocational Mathematics (e.g., agricultural mathematics, business mathematics 1 and 2)

- Basic Mathematics (e.g., consumer mathematics)

- Optional Mathematics (e.g., computer mathematics 1 and 2, mathematics in the arts).

2.2 Computer Science

Out of an appreciation that computer science is becoming increasingly separated into its own curriculum area, it was decided to it separately from mathematics, science, vocational education, and general education in the analysis. ETI relied on a computer program development specialist to suggest guidelines for the analysis of student participation patterns in computer science.

The study of computers has been tied to two different disciplines. Computer science has become associated with the discipline of mathematics, whereas data processing has allied itself with business. A third curriculum area is computer literacy. Current literature tends to include computer literacy under computer science.

The study of computer science in U.S. secondary schools includes coursework in the following areas:

- Computer Science Languages and Programming
- Business Data Processing Applications.

2.3 Science

Science is the organized knowledge that is gained through systematic empirical methods. The science programs listed in the CSSC were divided into two general categories: (1) life sciences and (2) physical sciences. Within these two categories, courses were grouped according to whether they were advanced or general level courses. 17/

2.4 Vocational Education

Although the group of vocational education specialists did not initially state a conceptual definition of vocational education, they later agreed on the following definition:

> Vocational education is any education that provides experiences, visual stimuli, affective awareness, cognitive information, or psychomotor skills; and that enhances the vocational development processes of exploring, establishing, and maintaining oneself in the world of work. 18/

At the secondary school level, vocational education includes coursework in the following nine areas:

- o Agriculture
- o Business

17/ The panel decided to exclude general science offerings from the analysis. This decision was based on the interdisciplinary nature of courses of this type, the differences in content and format of such courses across schools, and the fact that general science is offered as an eighth grade course in many schools.

18/ John F. Thompson, Foundations of Vocational Education, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1973.

- Marketing
- Health
- Industrial Arts
- Technologies
- Trade and Industry
- Consumer Home Economics
- Occupational Home Economics

2.5 General Education

General education is that common universe of discourse, understanding, and competence necessary for effective membership in a free society. 19/ As stated in the introduction to this report, it developed in the school system out of a concern for the education of the unique needs of the individual student. The general education curriculum is characterized by greater student freedom to choose courses from a wide variety of offerings. According to the general education project advisors, it is not possible to identify a set of high school courses that are broadly agreed upon as constituting general education courses. 20/ Courses are defined as general education offerings by their content and by the extent to which they adhere to the philosophy of general education. Moreover, general education courses as compared with academic courses are distinguished by the lower difficulty level and the lower expectations of student performance. While the material covered in a general education course is similar in content to that of other courses, the difficulty level of the concepts studied and the amount of material covered is reduced.

19/ D. Tanner and L. Tanner, Curriculum Development Theory Into Practice, 2nd ed., New York: MacMillian, 1980, p. 445.

20/ The exceptions may be general mathematics, general science, and general English.

In light of the nature of general education and the recommendations of the general education advisors, no attempt was made to identify a set of general education courses prior to the analysis. Rather, the analysis focused on identifying the courses taken by self-defined general education students and on the characteristics of these students. Thus, the approach to the analysis of course-taking behavior among general education students deviated from that which guided the analysis of students in other subject areas.

2.6 Student Course-taking Patterns

The conceptual and operational definitions of mathematics, computer science, science, vocational education, and general education provided the foundation for the analysis of student participation in these areas. For purposes of the study, student participation was defined in terms of the course-taking histories of secondary school students as represented in the HS&B student transcript data.

Mathematics Course-Taking Patterns

Each student sampled for the HS&B Transcripts Survey was classified into one of four mathematics participation patterns on the basis of his or her secondary school course-taking history. The operationalization of each pattern is a function of the intensity of participation in high school mathematics and the type(s) of mathematics courses a student took over his or her high school career. Intensity was measured by the number of Carnegie credits a student earned.

Before being assigned to a specific mathematics course-taking pattern, each student was first identified as being a college preparatory mathematics student or a non-college preparatory mathematics student. Once a student was assigned to one of these classifications, he or she was then assigned to one of the two patterns within that classification. This process is illustrated below:

A. College Preparatory Mathematics Student--defined as any student who has earned two or more credits from the college preparatory mathematics categories in addition to any credits earned in the general, vocational, basic, or optional mathematics categories (see CSSC codes in the Technical Appendix).

1. The Mathematics Concentrator -- a student who has earned four or more credits in mathematics, at least one of which was earned from the "college preparatory for gifted and talented students" category or the "college preparatory for mathematics concentrators" category (See CSSC codes in the Technical Appendix).

2. The 4-Year College Bound Mathematics Student -- a student who meets the conditions specified under the definition of the "College Preparatory Mathematics Student" in A, above, but not those specified under the Concentrator definition.

B. Non-college Preparatory Mathematics Student -- defined as any student who has earned less than two credits from college preparatory mathematics categories.

1. The General Mathematics Student -- a student who has earned one or more credits in mathematics but less than two credits in college preparatory mathematics courses.

2. Non-participant or Limited Participant -- a student who has earned less than one credit in mathematics.

Science Course-Taking Patterns

Secondary school participation in science courses is linked to the ability level of the student and to his or her postsecondary aspirations. Students with low to average ability and without any postsecondary education aspirations are most typically found in general science courses (e.g., general biology and general physical sciences). On the other hand, students with

above average abilities and those with college aspirations more often enroll in college preparatory and advanced science courses such as advanced biology, chemistry and physics. These patterns of student participation in secondary school science studies, plus a pattern reflecting no or limited secondary school study in the sciences, are operationalized below.

As with the mathematics course-taking patterns, each student was first categorized as being a college preparatory science student or a non-college preparatory science student. Next, the student was assigned to one of the two patterns within that category, as follows:

A. College Preparatory Science Student -- defined as any student who has earned one or more credits in advanced life science courses or in advanced physical science courses in addition to any credits earned in the general life and general physical science courses (see CSSC codes in the Technical Appendix).

   1. The Science Concentrator -- a student who has earned one or more credits in each of the following: biology, chemistry, and physics in addition to any credits earned in general science courses.

   2. The 4-Year College Bound Student -- a student who meets the conditions specified under the definition of the "College Preparatory Science Student" in A, above, but not those specified under the Concentrator definition.

B. Non-college Preparatory Science Student -- defined as any student who has earned less than one credit in advanced life science or advanced physical science courses.

   1. The General Science Student -- a student who has earned one or more credits in general life science or general physical science courses and less than one credit in advanced level science offerings.

   2. Non-participant or Limited Participant -- a student who has earned less than one credit in science.

Computer Science Course-Taking Patterns

Student involvement in computer science was measured in terms of participation in the two areas of study (i.e., computer science languages and programming and business data processing applications). This was done in recognition of the fact that computer science education in U.S.secondary schools is a relatively new phenomenon and that a relatively small percentage of all high school students have earned credits in these courses. The computer science course-taking patterns are operationalized as follows:

- o Participant -- a student who has earned any credit in computer science.
- o Non-participant -- a student who has earned no credit in computer science.

Vocational Education Course-Taking Patterns

Intensity of a student's participation, as measured by the number of Carnegie credits earned, served as the foundation for the vocational education course-taking patterns. In addition, the distribution of a student's credits across the instructional programs was taken into account.

Four patterns of participation in vocational education were identified:

- o Concentrator -- a student who has earned four or more credits in a single vocational education program. A student who has earned four or more credits each in multiple instructional programs (e.g., four credits in business and four credits in marketing) is included in this definition.
- o Limited Concentrator -- a student who earned four or more credits in vocational education but less than four in a single instructional program.
- o Sampler -- a student who has earned more than zero but less than four credits in vocational education.

- Non-participant -- a student who has earned no credits in vocational education.

General Education Course-Taking Patterns

General education was treated differently from mathematics, computer science, science, and vocational education in the analysis. Since it was not possible to identify a standard set of general education courses to define this curriculum alternative, no course-taking patterns were developed prior to the analysis. Instead, the identification of student participation patterns across subject areas was an outcome of the analysis. That is, course-taking profiles were developed for self-defined general education students.

These course-taking profiles were based on the types of courses general education students had taken during their high school careers and the intensity of their participation in these courses. The course categories developed for mathematics, computer science, science, vocational education, the arts, and the humanities were used for this purpose. 21/

21/ The instructional programs for each of these subject areas that were developed as part of prior analyses of the HS&B data were used for this purpose. Several of the mathematics and vocational education instructional programs differ slightly from the course groupings used to define mathematics and vocational education course-taking patterns. Listings of the courses comprising these instructional programs may be found in two Evaluation Technologies Incorporated reports:

Course Offerings and Enrollments in the Arts and Humanities at the Secondary School Level, Washington, D.C.: National Center for Education Statistics, June 29, 1984.

An Analysis of Course Offerings and Enrollments as Related to School Characteristics, Washington, D.C.: National Center for Education Statistics, October 2, 1984.

CHAPTER 3

COURSE-TAKING PATTERNS: OVERVIEW

This chapter presents an overview of our research findings concerning course-taking patterns in mathematics, science, vocational education, and computer science. It presents nationwide estimates of the number and percentage of students who exhibited various course-taking patterns in these subject areas as defined in Chapter 2. The chapter also includes research findings pertaining to the participation of general education students in the subject areas of interest.

3.1 Mathematics, Science, Vocational Education, and Computer Science Course-Taking Patterns

HS&B transcript data were examined to determine the number and percentage of secondary school students who participated to varying degrees in mathematics, science, vocational education, and computer science during their high school careers. The results of this analysis are shown in Table 1.

Only small percentages of students had concentrated in mathematics (8.6 percent) or science (9.3 percent). In each of these fields, the most prevalent pattern was what we have termed the "general" pattern in which the student had earned one or more mathematics credits but less than two in college preparatory mathematics courses. About half of all students conformed to this pattern. With respect to the sciences, about 47 percent of the students had earned at least one science credit but had not earned one credit in any advanced level life or physical science course. Nearly one in every twenty students had earned fewer than one mathematics credit, and about one in every six students had earned fewer than one science credit (limited participants or non-participants). 22/

22/ Caution should be exercised in interpreting this finding as any general/unified science (CSSC number 30.0111) credits earned were not included in determining a student's science course-taking behavior.

TABLE 1: PERCENTAGES AND NUMBER (THOUSANDS) OF STUDENTS WHO EXHIBITED SPECIFIED COURSE-TAKING PATTERNS IN MATHEMATICS, SCIENCE, VOCATIONAL EDUCATION, AND COMPUTER SCIENCE: 1981-82

Course-Taking Pattern	Percent	Number
Mathematics		
Concentrator	8.6	280
4-Year College Bound	36.6	1,194
General Mathematics Student	50.1	1,632
Non-participant or Limited Participant	4.7	152
Science		
Concentrator	9.3	304
4-Year College Bound	27.7	904
General Science Student	47.2	1,539
Non-participant or Limited Participant	15.7	513
Vocational Education		
Concentrator	24.8	807
Limited Concentrator	25.5	829
Sampler	45.3	1,477
Non-participant	4.5	146
Computer Science		
Participant	12.5	408
Non-participant	87.5	2,848

Overall, about 50 percent of the students exhibited either a strong vocational focus (concentrators) or a vocational interest (limited concentrators). One-fourth of the students had earned four or more credits in a single vocational education instructional program 23/ (e.g., agriculture, business, etc.) and a like number had earned four or more vocational credits across instructional programs. The largest single group of participants was comprised of those students who had earned some vocational credit but less than four credits across the instructional programs (samplers). Only 4.5 percent of the students nationwide had earned no vocational credit (non-participants).

As stated in Chapter 2, relatively few students were expected to have earned computer science credits. This expectation was supported by the distribution of computer science credits. Consequently, only two patterns of participation were examined--participant and non-participant. Approximately 13 percent, or 408,000 students, earned some computer science credit. This finding is not surprising given that only about 55 percent of all schools provided students with the opportunity to study this new technology as late as 1981-82. 24/

3.2 Relationships Among Subject Area Course-Taking Patterns

The findings reported above indicate that participation in mathematics and science follow much the same pattern. A supplementary analysis of the course-taking patterns of these two subject areas underscores these similarities. The findings of this analysis are presented in Table 2.

Students' patterns of participation in mathematics and science were strongly related. The majority of mathematics concentrators were either science

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23/ Students who earned four or more credits each in multiple instructional programs (e.g., four credits in business and four credits in marketing) are included in the definition of concentrators.

24/ Evaluation Technologies Incorporated, An Analysis of Course Offerings and Enrollments as Related to School Characteristics, Washington, D.C.: National Center for Education Statistics, October 2, 1984.

TABLE 2: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED COURSE-TAKING PATTERNS IN MATHEMATICS, SCIENCE, VOCATIONAL EDUCATION, AND COMPUTER SCIENCE AND THEIR COURSE-TAKING PATTERNS IN OTHER AREAS: 1981-82

Course-Taking Pattern in Other Areas	Course-Taking Pattern: Mathematics				Course-Taking Pattern: Science			
	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant	Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Mathematics								
Concentrator					42.9	13.2	1.9	.3
4-Year College Bound					53.0	60.0	28.4	10.7
General Mathematics Student					4.1	25.1	65.7	74.4
Non-participant or Limited Participant					0.0	1.7	4.0	14.5
Science								
Concentrator	46.4	13.5	.8	0.0				
4-Year College Bound	42.6	45.4	13.9	10.1				
General Science Student	10.5	36.6	62.0	40.8				
Non-participant or Limited Participant	.6	4.6	23.4	49.1				
Vocational Education								
Concentrator	5.5	16.6	33.9	29.1	3.4	14.7	32.0	33.4
Limited Concentrator	8.5	20.0	32.4	29.8	9.8	19.0	31.0	29.3
Sampler	74.4	58.2	31.8	36.5	76.1	60.4	35.1	31.3
Non-participant	11.6	5.2	1.9	13.4	10.7	5.9	2.0	6.0
Computer Science								
Participant	29.6	16.0	7.7	5.5	30.8	15.1	8.8	8.4
Non-participant	70.4	84.0	92.3	94.5	69.2	85.0	91.2	91.6

TABLE 2: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED COURSE-TAKING PATTERNS IN MATHEMATICS, SCIENCE, VOCATIONAL EDUCATION, AND COMPUTER SCIENCE AND THEIR COURSE-TAKING PATTERNS IN OTHER AREAS: 1981-82 (Cont.d)

Course-Taking Pattern in Other Areas	Course-Taking Pattern: Vocational Education				Course-Taking Pattern: Computer Science	
	Concentrator	Limited Concentrator	Sampler	Non-participant	Participant	Non-participant
Mathematics						
Concentrator	1.9	2.9	14.1	22.3	20.4	6.9
4-Year College Bound	24.6	28.8	47.0	42.8	46.8	35.2
General Mathematics						
Student	68.7	63.8	35.1	21.0	30.8	52.9
Non-participant or						
Limited Participant	4.7	4.6	3.8	15.9	2.0	4.9
Science						
Concentrator	1.3	5.6	19.6	22.2	22.9	7.4
4-Year College Bound	16.9	20.7	37.0	36.3	33.3	26.9
General Science						
Student	61.0	57.5	36.6	20.9	33.2	49.2
Non-participant or						
Limited Participant	21.3	16.2	10.9	21.0	10.6	16.5
Vocational Education						
Concentrator					17.1	29.8
Limited Concentrator					28.3	25.9
Sampler					52.1	44.4
Non-participant					2.5	4.8
Computer Science						
Participant	8.7	13.9	14.4	7.0		
Non-participant	91.3	86.1	85.6	93.0		

concentrators (46 percent) or 4-year college bound science students (43 percent). Conversely, about 96 percent of all science concentrators were either mathematics concentrators or 4-year college bound mathematics students. The 4-year college bound pattern in both mathematics and science was strongly linked to either a 4-year college bound or a general level of participation in the other area (for example, a 4-year college bound mathematics student was likely to be either a 4-year college bound science student or a general science student). Nearly one-half of the students who earned fewer than one mathematics credit earned a similar number of credits in science. Limited participation or non-participation in the sciences was most commonly associated with general mathematics participation (74 percent).

Vocational education course-taking patterns were also examined in relation to those of mathematics and science. As might be expected, concentration in vocational education was most strongly associated with a general level of participation in both of these subject areas. Nevertheless, about one-fourth of all the vocational education concentrators and limited concentrators met the requirements of the 4-year college bound mathematics pattern. A majority of the vocational education samplers had met the definition of a 4-year college bound mathematics or science student (47 percent and 37 percent, respectively) or the definition of a general student in these subject areas (35 percent and 37 percent, respectively). About 75 percent of the mathematics concentrators and 76 percent of the science concentrators were vocational education samplers, having earned some vocational education credit. These findings indicate that intense participation in mathematics and science did not preclude students from seeking vocational training, nor did intense participation in vocational education preclude students from earning credit in college preparatory mathematics and science courses.

Not surprisingly, participation in computer science was most commonly related to more advanced level participation in mathematics. About 20 percent of the students who earned computer science credit concentrated in mathematics, and 47 percent were 4-year college bound mathematics students. Only two percent of the students who had earned computer science credit had earned less than one credit in mathematics.

The relationship between computer science participation and science course-taking patterns was similar to that for mathematics; however, a smaller percentage of computer science participants were college preparatory science students. Furthermore, a higher percentage of the computer science participants (10.6 percent) had earned less than one science credit than had earned less than one mathematics credit.

The involvement of computer science participants in vocational education was most often as a sampler (52 percent) and least often as a non-participant (2.5 percent). This finding was not unexpected given that college preparatory mathematics students were typically vocational education samplers.

3.3 Course-Taking History of General Education Students

As previously stated, there is no set of secondary school courses than can be used to define a general education curriculum. Therefore, it was not possible to define the course-taking patterns of general education in the same way as the course-taking patterns in mathematics, science, vocational education, and computer science. Instead, the average number of credits in different subject areas that were earned by students who considered themselves to be in a general education program was examined. The findings of this analysis are presented in Table 3.

When asked to describe their high school program as part of the HS&B First Follow-Up Survey, over one-third (35.1 percent) of the students defined it as general. 25/ The average number of credits earned by these self-defined

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25/ Students' self-reported description of their high school program was examined with respect to their course-taking patterns in mathematics, science, vocational education, and computer science. A majority of these students were general mathematics students (63 percent). About 86 percent of the self-defined general education students were general science or limited/non-participating science students, while 91 percent were computer science non-participants. With respect to vocational education, 57 percent of the general education students were concentrators or limited concentrators, and 41 percent were samplers.

TABLE 3: AVERAGE NUMBER OF CREDITS EARNED BY GENERAL EDUCATION STUDENTS IN ARTS, HUMANITIES, MATHEMATICS, SCIENCE, VOCATIONAL EDUCATION, AND COMPUTER SCIENCE INSTRUCTIONAL PROGRAMS: 1981-82

Instructional Program	General Education Students	All Other Students
Arts	1.5	1.5
Dance	•	•
Dramatic Arts and Design	.1	.1
Graphic and Commercial Arts	•	•
Crafts	.1	.1
Fine Arts	.5	.4
Music	.7	.7
Creative Writing	•	•
Humanities	5.9	6.9
Multi-Disciplinary and Inter-Disciplinary Studies	•	•
Philosophy and Religion	•	.1
Foreign Languages	.6	1.2
History	1.4	1.4
Anthropology and Cultural Geography	.4	.4
English and the Study of Literature	3.1	3.2
Rhetoric and Composition	.4	.4
Cultural Appreciation	•	•
Mathematics	2.0	2.6
General Mathematics 1	.5	.4
General Mathematics 2	.3	.2
General Mathematics, Other	•	•
Algebra 1	.5	.6
Algebra 2	.2	.3
Algebra 3	.1	.2
Geometry	.3	.5
Advanced and Pure Mathematics	.1	.3
Calculus, Advanced Placement	•	•
Statistics, Applied Mathematics and Actuarial Science	•	•
Science	1.5	2.0
Biology, General	.7	.8
Biology, College Preparatory	.1	.2
Life Sciences, Other	•	•
Physical Sciences, General	.3	.3

• Students earned an average of less than .1 credit.

TABLE 3: AVERAGE NUMBER OF CREDITS EARNED BY GENERAL EDUCATION STUDENTS IN ARTS, HUMANITIES, MATHEMATICS, SCIENCE, VOCATIONAL EDUCATION, AND COMPUTER SCIENCE INSTRUCTIONAL PROGRAMS: 1981-82 (Continued)

Instructional Program	General Education Students	All Other Students
Physical Sciences, Other	*	*
Chemistry	.2	.4
Geological Sciences	.1	.1
Physics	.1	.2
Vocational Education	4.4	4.1
Agriculture	.2	.2
Business	1.4	1.6
Marketing	.1	.2
Health	*	.1
Industrial Arts	.4	.3
Technologies	*	*
Trade and Industry	1.1	1.0
Consumer Home Economics	.6	.6
Occupational Home Economics	.2	.2
Computer Science	.1	.1
Computer Science Languages and Programming	*	.1
Business Data Processing Applications	*	*

* Students earned an average of less than .1 credit.

general education students suggests that they experienced less exposure to the humanities, mathematics, and the sciences than did other students (i.e., college preparatory and vocational education students). Overall, general education students earned about one less credit in the humanities and about one-half less credit in mathematics and science than did other students.

The credit differential in the humanities was attributed primarily to general education students' earning fewer foreign language credits. In mathematics, general education students earned slightly fewer credits in most of the upper level offerings. A similar pattern held with respect to advanced level science courses. General education students earned about the same number of credits in the arts and vocational education as did students in other programs.

CHAPTER 4

CHARACTERISTICS OF STUDENTS EXHIBITING VARIOUS COURSE-TAKING PATTERNS IN MATHEMATICS

This chapter presents the findings of our analysis relating mathematics course-taking patterns to selected student characteristics. The characteristics that are examined fall into three categories: (1) socio-demographic attributes; (2) school performance and experiences; and (3) postsecondary plans and aspirations. Findings relating these characteristics to science, vocational education, computer science, and general education are presented in Chapters 5 through 8.

The findings reported in Chapter 3 suggest that students differed with respect to their participation in high school mathematics, with this participation ranging from intense (concentrators) to limited or no involvement. The findings presented in Tables 4 through 12 identify the characteristics of students in each of the mathematics course-taking patterns. All of the differences described in this and the remaining chapters are at least two times the standard error of the difference and therefore are statistically significant.

4.1 Socio-demographic Attributes

Course-taking patterns were examined relative to students' sex, socio-economic status, race/ethnicity, and the type of school they attended. This information is summarized in Tables 4 and 5.

The distribution of students across the various course-taking patterns was much the same for males and females. Moreover, the percentage of males and females within each pattern appeared to be roughly equivalent to their representation in the student population. For example, while males comprised about 49 percent of the student population and females about 51 percent, each represented approximately 5[illegible] percent of the general mathematics students. The relationship between mathematics course-taking behavior and

TABLE 4: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED MATHEMATICS COURSE-TAKING PATTERNS, BY SEX, SOCIO-ECONOMIC STATUS, AND RACE/ETHNICITY: 1981-82

Mathematics Course-Taking Pattern	Sex		Socio-economic Status			Race/Ethnicity		
	Male	Female	Low	Middle	High	White	Black	Hispanic/Other
Concentrator	9.3 (53.1)[a/]	8.0 (46.9)	2.4 (7.0)	7.8 (44.2)	17.0 (48.9)	10.3 (87.1)	3.3 (4.3)	4.7 (8.7)
4-Year College Bound	34.7 (46.8)	38.5 (53.2)	22.7 (15.1)	37.9 (50.0)	52.1 (34.9)	41.2 (81.7)	24.8 (7.7)	24.2 (10.6)
General Mathematics Student	51.0 (50.3)	49.2 (49.7)	68.9 (35.1)	49.8 (50.1)	29.0 (14.8)	44.9 (65.0)	66.4 (15.0)	62.4 (20.0)
Non-participant or Limited Participant	5.0 (52.7)	4.4 (47.3)	6.0 (35.6)	4.6 (53.3)	1.9 (11.1)	3.6 (56.2)	5.6 (13.6)	8.8 (30.2)

a/ The figures in parentheses represent the percentage of students within each pattern who possessed the designated characteristic. For example, among mathematics concentrators, 53.1 percent were male and 46.9 percent were female.

socio-economic status was much stronger. Participation in college preparatory mathematics courses, both as a concentrator and as a 4-year college bound student, was positively associated with SES. Seventeen percent of the high SES students concentrated in mathematics, and 52 percent of these students were defined as 4-year college bound as compared with nearly two percent and 23 percent, respectively, of the low SES students. Conversely, the percentage of students defined as general mathematics students or non-participants/limited participants was larger among the low SES students.

Low SES students were especially underrepresented among the mathematics concentrators and 4-year college bound relative to their numbers in the student population. While these students comprised approximately 25 percent of the student population, they represented only seven percent of the concentrators and 15 percent of the 4-year college bound. Middle SES students were slightly underrepresented among the concentrators, and high SES students were substantially overrepresented.

Race/ethnicity, like SES, was related to mathematics course-taking patterns. White students were much more likely than other students to be mathematics concentrators or 4-year college bound mathematics students. Black students, in particular, were underrepresented among the mathematics concentrators relative to their representation in the population. Furthermore, Hispanic other students represented only about nine percent of the mathematics concentrators although they accounted for about 16 percent of the student population. Conversely, Hispanic/other students were overrepresented among the non-participant/limited participant category.

The type of school that students attended was related to their participation in mathematics (see Table 5). As one might expect, private schools had a higher percentage of their students participating at a college preparatory level than did public schools. The percentage of Catholic school and other private school students who had concentrated in mathematics was roughly three times that of public school students. On the other hand, public

TABLE 5: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED MATHEMATICS COURSE-TAKING PATTERNS, BY SCHOOL TYPE: 1981-82

Mathematics Course-Taking Pattern	School Type		
	Public	Catholic	Other Private
Concentrator	6.9	23.4	23.9
4-Year College Bound	35.0	52.5	48.4
General Mathematics Student	53.1	22.3	26.7
Non-participant or Limited Participant	5.0	1.7	1.0

school students were about twice as likely to have been general mathematics students. 26/ Public school students were also more likely to have been non-participants/limited participants.

4.2 School Performance and Experiences

The various components of the HS&B First Follow-Up Survey collected data that may be used to measure different aspects of students' performance and experiences. For example, the HS&B Transcript Survey collected data on the grades that students earned while in high school. These data, along with course credit data, were used to calculate an average grade for each student.

Moreover, as part of the 1982 First Follow-Up Survey, students were administered cognitive tests in reading, vocabulary, and mathematics. For the purpose of this analysis, the average of the three standardized scores on these tests were grouped by quartiles, reflecting whether a student's average score fell in the lowest, second, third, or highest quartile of the distribution of the all student scores. 27/

26/ An earlier study conducted by Evaluation Technologies Incorporated for the NCES found that private schools offered more advanced level mathematics courses and that enrollments in these courses were higher as compared with public schools. Public schools had higher general mathematics enrollments. See Evaluation Technologies Incorporated, An Analysis of Course Offerings and Enrollments as Related to School Characteristics, Washington, D.C.: National Center for Education Statistics, October 2, 1984.

27/ Test scores were standardized so that the weighted distribution of scores would have a mean of 50 and a standard deviation of 10. For more information on the tests and the composite scales used here, see High School and Beyond 1980 Sophomore Cohort First Follow-Up (1982): Data File User's Manual.

Finally, the questionnaire administrated to the First Follow-Up sophomore sample contained a series of questions relating to the student's participation in a variety of extra-curricular activities. The responses to these questions were used to determine the types of activities engaged in by students who had participated in mathematics at varying levels.

Each of these measures of students' school performance and experiences is examined in Tables 6 through 8 of this section.

The overall grade averages of students differed according to their level of participation in mathematics (see Table 6). A significantly higher percentage of concentrators (69.9 percent) had an overall grade average of B or higher than did 4-year college bound (42.7 percent), general mathematics students (12.5 percent), or non-participants/limited participants (10 percent). Conversely, the majority of general mathematics students (63.7 percent) and non-participants/limited participants (68.1 percent) had overall grade averages of C or lower.

Students who were mathematics concentrators performed significantly better on the reading, vocabulary, and mathematics tests than did students exhibiting the other mathematics course-taking patterns (see Table 7). General mathematics students and non-participants/limited participants generally had scores falling into the lowest two quartiles. These findings are consistent with the view that lower achievement scores are, in part, attributable to students' limited mathematics participation. It is equally plausible to suppose that weaker students tend to avoid mathematics.

Table 8 presents findings relating to extra-curricular activities. In general, students who had participated in mathematics more intensely were also more likely to have engaged in many of the school-sponsored activities. Concentrators were more likely to have participated in honorary clubs and the production of a school newspaper/yearbook than were the other classifications of students. These students, along with the 4-year college bound, were more likely to have participated in service clubs/community service activities and athletics and were less likely to have participated in vocational education clubs.

TABLE 6: PERCENTAGES OF STUDENTS WITH OVERALL GRADE AVERAGES AT SPECIFIED LEVELS, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

Overall Grade Average	Mathematics Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant
A	1.1	.3	.1	.4
A-	36.0	15.0	2.5	.8
B	32.8	27.4	9.9	8.8
B-	22.8	31.9	25.9	22.0
C	6.1	19.5	36.6	35.4
C-	1.2	5.3	23.2	25.8
D	0.0	.6	3.9	6.9
D-	0.0	0.0	0.0	0.0
F	0.0	0.0	0.0	0.0

TABLE 7: PERCENTAGES OF STUDENTS WHOSE COMPOSITE VOCABULARY, VERBAL, AND MATHEMATICS TEST SCORES FELL INTO THE LOWEST, SECOND, THIRD, AND HIGHEST QUARTILES, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

	Mathematics Course-Taking Pattern			
Test Score Quartile	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant
Lowest Quartile	.5	4.6	35.1	31.5
Second Quartile	3.4	16.9	32.2	35.8
Third Quartile	12.8	33.7	23.3	24.2
Highest Quartile	83.3	44.8	9.5	8.6

TABLE 8: PERCENTAGES OF STUDENTS WHO HAD PARTICIPATED IN SPECIFIED EXTRA-CURRICULAR ACTIVITIES, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

Extra-Curricular Activity	Mathematics Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant
Varsity Athletics	48.5	40.3	28.6	24.7
Other Athletic Teams	47.3	43.3	37.8	36.0
Cheerleading, Pep Club	15.0	15.4	12.6	10.4
Debating or Drama	17.6	15.1	10.6	10.6
Band or Orchestra	17.0	16.9	11.5	15.4
Chorus or Dance	17.2	20.5	19.4	17.9
Hobby Clubs	20.1	17.8	19.8	22.5
Honorary Clubs	47.0	22.8	6.5	.8
School Newspaper/Yearbook	30.0	21.6	13.2	14.1
School Subject-Matter Clubs	28.4	23.3	18.0	15.8
Student Council/Government	26.8	20.7	11.0	12.6
Vocational Education Clubs	7.4	17.4	31.0	29.1
Youth Community Organizations	20.3	18.3	14.8	13.1
Church Activities/Youth Groups	37.7	40.5	33.4	33.2
Junior Achievement	4.5	4.9	6.3	7.1
Service Clubs/Community Service Activities	25.4	18.4	12.1	12.3
Sororities/Fraternities	2.5	2.4	2.8	2.5

4.3 Postsecondary Plans and Aspirations

Students were asked about the level of education which they expected to attain,their short-term plans for the year after graduation from high school, and their long-range occupational goals. Furthermore, those students who planned to attend college were asked to identify the field of study that they would most likely pursue. Student responses to these inquiries are presented by mathematics course-taking pattern in Tables 9 through 12.

The immediate post-graduation plans of students varied rather markedly by mathematics course-taking pattern (see Table 9). A much larger percentage of general mathematics students and non-participants/limited participants planned to work full-time or attend a trade or business school as compared with mathematics concentrators and 4-year college bound students. Conversely, a significantly higher percentage of these latter two groups planned to attend a 4-year college or university. Surprisingly, about 11 percent of the non-participants/limited participants indicated that they planned to attend a 4-year college or university.

There is a strong relationship between mathematics course-taking patterns and students' educational expectations (see Table 10). As expected, a significantly higher percentage of general mathematics students and non-participants/ limited participants expected to attain no education beyond high school or expected to attend a vocational, trade, or business school than did mathematics concentrators and 4-year college bound students. On the other hand, concentrators and 4-year college bound students were more likely to aspire to a 4- or 5-year college degree, a master's degree, and another advanced degree.

For the most part, students shared similar job aspirations regardless of mathematics course-taking pattern (see Table 11). Nevertheless, some differences were apparent. General mathematics students and non-participants/ limited participants were more likely to expect to have a job in a clerical or craftsman occupation at age 30. A much larger percentage of concentrators and 4-year college bound students expected to have professional jobs as compared with other students.

TABLE 9: PERCENTAGES OF STUDENTS WHO EXPECTED TO ENGAGE IN SPECIFIED ACTIVITIES FOR THE FIRST YEAR AFTER GRADUATION, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

Activity That Will Take The Largest Share of Time the Year After High School	Mathematics Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant
Working full-time	5.5	18.5	45.6	48.6
Apprentice or on-the-job training	.6	1.3	3.1	.8
Regular military service (or service academy)	1.2	3.0	5.5	6.3
Full-time homemaker	0.0	.9	2.0	2.7
Taking courses full-time or part-time at:				
A trade or business school	1.4	4.7	8.2	9.0
A junior or community college:				
Academic courses	6.9	12.3	8.2	9.4
Technical courses	1.3	4.5	5.0	4.9
A 4-year college or university	80.7	50.9	16.4	10.8
Working part-time, but not attending school	1.7	1.8	2.5	2.9
Other (travel, take a break, no plans)	.8	2.1	3.6	4.6

TABLE 10: PERCENTAGES OF STUDENTS WHO EXPECTED TO OBTAIN SPECIFIED KINDS AND LEVELS OF EDUCATION, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

Educational Expectation	Mathematics Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited participant
Less than High School Graduation	.2	.1	.8	2.3
High School Graduation	1.0	7.1	29.0	30.5
Vocational, Trade or Business School After High School-				
Less Than Two Years	.5	4.7	12.2	12.3
Two or More Years	1.6	8.0	17.1	17.4
College - Less than 2 Years	.8	2.5	3.6	6.3
College - 2 or More Years	8.7	16.4	16.2	14.1
College Completion - 4 or 5 Year Degree	40.3	34.3	12.5	11.7
Master's Degree or Equivalent	25.6	16.0	5.0	3.1
Ph.D., M.D., or Other Advanced Professional Degree	21.5	11.0	3.6	2.5

TABLE 11: PERCENTAGES OF STUDENTS WHO EXPECTED TO HOLD SPECIFIED JOBS OR OCCUPATIONS WHEN 30 YEARS OLD, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

Occupation	Mathematics Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant
Clerical	1.2	6.4	11.7	10.3
Craftsman	.5	3.6	11.1	10.7
Farmer, Farm Manager	.7	1.2	2.7	2.3
Homemaker	1.3	2.2	3.0	3.6
Laborer	0.0	.6	2.4	3.3
Manager, Administrator	6.8	9.4	7.2	6.5
Military	1.1	1.4	3.0	3.0
Operative	.4	1.3	5.0	4.5
Professional - No Advanced Degree	44.6	32.9	20.1	18.2
Professional - Advanced Degree	24.0	13.5	5.1	3.6
Proprietor or Owner	1.5	4.1	5.3	7.1
Protective Service	.5	1.4	2.6	2.0
Sales	.7	1.9	2.0	3.1
School Teacher	2.5	4.6	2.7	3.1
Service	.4	2.1	6.0	7.1
Technical	13.8	13.3	9.1	10.6
Not Working	.2	.2	1.0	1.1

Interestingly, professional occupations requiring no advanced degree were the expected occupations of a plurality of students in each of the mathematics course-taking patterns. Entrance into each of these professions requires a college degree. Yet, many students have not earned sufficient credits in advanced level mathematics courses to improve their chances of entering college in order to obtain a job in a professional capacity.

When students were compared with respect to their intended field of study in college, only a few differences emerged (see Table 12). Mathematics concentrators were more likely than other students to plan to study architecture and engineering or the biological and physical sciences. On the other hand, concentrators were less likely to study business and somewhat less likely to study art and music. General mathematics students and non-participants/limited participants were more likely than other students to plan to take up vocational/technical studies.

TABLE 12: PERCENTAGES OF COLLEGE-BOUND STUDENTS WHO PLANNED TO ENROLL IN SPECIFIED FIELDS OF STUDY, BY MATHEMATICS COURSE-TAKING PATTERN: 1981-82

	Mathematics Course-Taking Pattern			
Field of Study	Concentrator	4-Year College Bound	General Mathematics Student	Non-participant or Limited Participant
Agriculture	1.0	1.9	3.1	4.4
Architecture and Engineering	23.1	11.3	6.6	6.1
Art and Music	1.5	5.5	8.5	9.4
Biological and Physical Sciences	8.0	4.1	1.8	1.0
Business	13.8	22.9	21.8	20.4
Communications	2.5	3.5	5.4	1.7
Computer and Information Sciences	12.0	8.4	6.9	9.7
Education	3.2	4.2	4.0	3.9
English and Foreign Languages	2.0	2.9	1.9	1.1
Ethnic and Inter-disciplinary Studies	.3	.1	.2	0.0
Health Occupations	2.9	4.6	6.0	3.9
Health Sciences	5.5	5.4	4.8	4.1
Home Economics	.8	1.5	2.8	3.0
Mathematics	2.9	.8	.1	0.0
Philosophy and Religion	.7	.4	.2	.3
Pre-Professional	10.5	7.3	3.1	3.3
Psychology and Social Sciences	4.7	5.5	5.4	4.9
Vocational/Technical Studies	1.8	4.5	10.9	12.3
Other	2.9	5.1	8.6	10.7

CHAPTER 5

CHARACTERISTICS OF STUDENTS EXHIBITING VARIOUS COURSE-TAKING PATTERNS IN SCIENCE

The findings of the analysis reported in Chapter 3 indicate that science course-taking patterns were strongly related to those of mathematics. Therefore, we would expect the characteristics of students exhibiting the different science course-taking patterns to resemble those associated with the different mathematics patterns. For the most part, the findings summarized in the following sections of this chapter support this expectation.

5.1 Socio-demographic Attributes

Student participation in the sciences was examined relative to several distinguishing student and school characteristics. Table 13 presents the findings of this analysis.

A higher percentage of males than of females were science concentrators (11.6 percent versus 7.1 percent). Males were substantially overrepresented among the science concentrators (61.4 percent) and females underrepresented (38.6 percent) relative to their representation in the student population. A higher percentage of females were general science students, whereas in mathematics a general level of participation was unrelated to sex.

Science course-taking behavior was strongly related to students' SES. Participation at the college preparatory level increased with SES. That is, a higher percentage of students in the middle and high SES categories were defined as concentrators and 4-year college bound students as compared with low SES students. General science participation and non-participation/limited participation were inversely associated with SES. As with mathematics, low SES students were underrepresented among science concentrators and the 4-year college bound. Moreover, while low SES students comprised about one-fourth of the student population, they represented 38 percent of the non-participation/limited participation science category.

TABLE 13: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED SCIENCE COURSE-TAKING PATTERNS, BY SEX, SOCIO-ECONOMIC STATUS, AND RACE/ETHNICITY: 1981-82

Science Course-Taking Pattern	Sex		Socio-economic Status			Race/Ethnicity		
	Male	Female	Low	Middle	High	White	Black	Hispanic/Other
Concentrator	11.6 (61.4)[a/]	7.1 (38.6)	3.2 (8.5)	8.3 (43.2)	18.4 (48.4)	11.0 (85.9)	4.0 (4.8)	5.4 (9.2)
4-Year College Bound	26.6 (47.4)	26.8 (52.6)	16.4 (14.5)	28.0 (50.3)	39.9 (35.2)	30.7 (80.4)	22.1 (9.0)	18.4 (10.6)
General Science Student	44.8 (46.8)	49.6 (53.2)	57.8 (30.8)	48.3 (50.9)	34.1 (18.3)	45.0 (69.1)	54.4 (13.0)	52.5 (17.8)
Non-participant or Limited Participant	17.0 (53.4)	14.5 (46.6)	22.6 (38.3)	14.6 (48.8)	7.6 (13.0)	13.4 (61.7)	19.6 (14.1)	23.8 (24.3)

a/ The figures in parentheses represent the percentage of students within each pattern who possessed the designated characteristic. For example, among science concentrators, 61.4 percent were male and 38.6 percent were female.

White students earned more advanced level science credits than did black or Hispanic/other students. Nearly 42 percent of the white students were science concentrators or 4-year college bound as compared with 26 percent and 24 percent, respectively, of students from the other racial/ethnic groups. Students from the latter groups were significantly underrepresented among the college preparatory patterns relative to their numbers in the total student population.Hispanic/other students represented about 24 percent of all science non-participants/limited participants though they accounted for about 16 percent of the students attending U.S. secondary schools.

The differences in the percentage of public and private school students exhibiting the various patterns of science participation were not as pronounced as they were with respect to mathematics (see Table 14). Nevertheless, there was a pattern of more intense participation in the advanced sciences in private schools as compared with public schools. In contrast, public school students were more likely to have participated at more general or limited levels than were private school students. 28/

5.2 Student Performance and Experiences

Two measures are typically used to assess student performance: (1) grade average and (2) scores on standardized tests. These measures are examined with respect to science course-taking patterns in Tables 15 and 16. Student experiences, as measured by participation in extra-curricular activities, are presented in Table 17.

The findings in Table 15 suggest that students who had participated at a more advanced level in the sciences had higher overall grade averages than did other students. For example, a significantly higher percentage of science concentrators had an overall grade average of B or higher (67.1 percent) than did 4-year college bound (42 percent), general science students (18.7 percent) or non-participants/limited participants

28/ Estimates for other private school students may be less accurate than others because of the small sample size and lower response rate.

TABLE 14: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED SCIENCE COURSE-TAKING PATTERNS, BY SCHOOL TYPE: 1981-82

Science Course-Taking Pattern	School Type		
	Public	Catholic	Other Private*
Concentrator	8.5	17.3	14.9
4-Year College Bound	26.6	38.4	35.9
General Science Student	48.0	39.8	42.6
Non-participant or Limited Participant	17.0	4.5	6.7

*Estimates for other private schools may be less accurate than others because of the small sample size and lower response rate.

TABLE 15: PERCENTAGES OF STUDENTS WITH OVERALL GRADE AVERAGES AT SPECIFIED LEVELS, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

Overall Grade Average	Science Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
A	1.0	.4	0.0	.1
A-	32.4	16.3	4.1	2.8
B	33.7	2[illegible].3	14.6	7.7
B-	23.0	30.4	26.2	23.8
C	8.6	19.5	34.1	33.9
C-	1.4	7.4	18.2	25.9
D	0.0	.8	2.8	5.8
D-	0.0	0.0	0.0	0.0
F	0.0	0.0	0.0	0.0

(10.6 percent). Conversely, a majority of general science students and non-participants/limited participants earned overall averages of C or lower (55.1 percent and 65.6 percent, respectively) in contrast to concentrators (10 percent) and 4-year college bound students (27.7 percent).

As with mathematics, there was a strong relationship between science coursetaking patterns and students' cognitive test scores (see Table 16). A large majority of science concentrators scored in the highest quartile (nearly 80 percent) as compared with the other classifications of students. Moreover, when the third and highest quartiles are taken together, the scores of nearly 95 percent of all science concentrators are represented as compared with 42.1 percent of general science students and 39.2 percent of non-participants/ limited participants.

Table 17 summarizes information on students' participation in various extracurricular activities by science course-taking pattern. Concentrators were far more likely to participate in varsity sports, other athletics, and honorary clubs than were other classifications of students. Concentrators and 4-year college bound students were more likely than other students to be involved in school newspaper/yearbook activities, serve on the student council/government, and participate in service clubs/ community service activities. As was found with respect to mathematics, general science students and non-participants/limited participants were more likely to be members of vocational education clubs.

5.3 Postsecondary Plans and Aspirations

Only a few differences emerged with respect to the activities that students expected to engage in for the first year after graduation (see Table 16). General science students and non-participants/limited participants were significantly more likely than others to anticipate working full-time. Furthermore, non-participants/limited participants were somewhat more likely to anticipate attending a trade or business school than were concentrators, while concentrators and 4-year college bound students expressed a far greater likelihood of attending a 4-year college or university.

TABLE 16: PERCENTAGES OF STUDENTS WHOSE COMPOSITE VOCABULARY, VERBAL, AND MATHEMATICS TEST SCORES FELL INTO THE LOWEST, SECOND, THIRD, AND HIGHEST QUARTILES, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

	Science Course-Taking Pattern			
Test Score Quartile	Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Lowest Quartile	.5	7.2	26.5	40.0
Second Quartile	4.7	15.1	31.4	30.7
Third Quartile	15.1	31.3	27.1	21.6
Highest Quartile	79.7	46.4	15.0	7.6

TABLE 17: PERCENTAGES OF STUDENTS WHO HAD PARTICIPATED IN SPECIFIED EXTRA-CURRICULAR ACTIVITIES, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

Extra-Curricular Activity	Science Course-Taking Pattern: Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Varsity Athletics	51.4	39.3	30.7	26.9
Other Athletic Teams	50.8	43.0	38.7	35.6
Cheerleading, Pep Club	13.5	14.1	14.4	11.2
Debating or Drama	18.9	14.9	11.5	9.5
Band or Orchestra	17.5	17.0	12.6	11.6
Chorus or Dance	16.5	19.0	20.4	20.0
Hobby Clubs	19.0	19.2	18.7	21.1
Honorary Clubs	42.6	25.1	8.5	5.6
School Newspaper/Yearbook	26.9	21.9	15.3	12.5
School Subject-Matter Clubs	24.7	25.2	18.6	16.7
Student Council/Government	24.8	21.8	12.6	10.6
Vocational Education Clubs	7.3	17.6	30.2	25.3
Youth Community Organizations	21.6	20.4	13.5	15.5
Church Activities/Youth Groups	41.2	40.4	35.1	30.2
Junior Achievement	4.6	4.9	6.0	6.8
Service Clubs/Community Service Activities	25.2	19.7	12.5	11.6
Sororities/Fraternities	2.2	2.8	2.4	3.2

TABLE 18: PERCENTAGES OF STUDENTS WHO EXPECTED TO ENGAGE IN SPECIFIED ACTIVITIES FOR THE FIRST YEAR AFTER GRADUATION, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

Activity That Will Take The Largest Share of Time The Year After High School	Science Course-Taking Pattern: Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Working full-time	5.4	17.8	40.8	48.4
Apprentice or on-the-job training	1.1	1.5	2.5	2.5
Regular military service (or service academy)	1.9	2.9	4.6	6.9
Full-time homemaker	0.0	.9	1.7	2.5
Taking courses full-time or part-time at:				
A trade or business school	1.3	4.7	7.3	9.5
A junior or community college:				
Academic courses	8.3	11.9	9.3	7.2
Technical courses	2.0	4.0	5.3	4.5
A 4-year college or university	77.6	52.3	22.5	12.2
Working part-time, but not attending school	1.2	2.0	2.5	2.5
Other (travel, take a break, no plans)	1.3	1.9	3.5	3.7

When asked about their educational expectations, a significantly higher percentage of general science students and non-participants/limited participants stated that they expected their formal education to end with graduation from high school (see Table 19). A larger percentage of these same students stated that they expected their education to include vocational, trade, or business school than was indicated by concentrators and 4-year college bound students. As expected, concentrators and 4-year college bound students were more likely to state that they expected to complete college or earn an advanced degree.

As the findings in Table 20 indicate, there were few marked differences in the occupational aspirations of science participants across the different course-taking patterns. Regardless of their course-taking pattern, the largest percentage of students saw themselves as being a professional without an advanced degree at age 30. However, a larger percentage of concentrators expressed these aspirations than did other classifications of students. Science concentrators were also more likely to aspire to professions requiring an advanced degree. On the other hand, non-participants/limited participants were more likely to see themselves in a clerical or craftsman occupation at age 30 than were science concentrators and the 4-year college bound.

Science concentrators differed from other students with respect to the field of study they planned to pursue in college (see Table 21). Concentrators were more likely to identify architecture, engineering, the biological and physical sciences, and pre-professional fields as their planned area of college study. At the same time, concentrators were less likely to study business, art, and music. Non-participants/limited participants were more likely to identify vocational/technical studies as their planned college curriculum.

TABLE 19: PERCENTAGES OF STUDENTS WHO EXPECTED TO OBTAIN SPECIFIED KINDS AND LEVELS OF EDUCATION, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

Educational Expectation	Science Course-Taking Pattern			
	Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Less than High School Graduation	.2	.2	.5	1.7
High School Graduation	1.2	7.8	23.8	32.0
Vocational, Trade or Business School After High School-				
Less Than 2 Years	.2	3.8	11.1	13.7
Two or More Years	1.6	8.5	15.9	16.6
College - Less than 2 Years	.2	2.0	4.0	5.9
College - 2 or More Years	10.0	19.4	14.9	15.0
College Completion - 4 or 5 Year Degree	37.0	35.0	17.2	10.5
Master's Degree or Equivalent	21.7	16.5	6.9	3.8
Ph.D., M.D., or Other Advanced Professional Degree	25.1	11.0	4.2	2.8

TABLE 20: PERCENTAGES OF STUDENTS WHO EXPECTED TO HOLD SPECIFIED JOBS OR OCCUPATIONS WHEN 30 YEARS OLD, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

	Science Course-Taking Pattern			
Occupation	Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Clerical	.9	4.5	11.9	11.5
Craftsman	.8	3.6	9.1	12.8
Farmer, Farm Manager	1.7	1.5	2.0	2.9
Homemaker	.3	2.3	2.9	3.6
Laborer	.2	.6	1.7	3.5
Manager, Administrator	5.3	9.3	8.0	7.1
Military	1.2	1.6	2.6	2.8
Operative	.6	1.4	4.4	4.6
Professional - No Advanced Degree	41.8	33.9	22.1	19.7
Professional - Advanced Degree	28.8	13.9	5.7	3.1
Proprietor or Owner	1.1	3.8	5.3	6.1
Protective Service	.7	1.6	2.4	2.1
Sales	.7	1.9	2.2	1.6
School Teacher	2.6	4.1	3.5	2.3
Service	.6	2.1	5.4	6.2
Technical	12.7	13.8	9.9	9.3
Not Working	.1	.3	.9	1.0

TABLE 21: PERCENTAGES OF COLLEGE-BOUND STUDENTS WHO PLANNED TO ENROLL IN SPECIFIED FIELDS OF STUDY, BY SCIENCE COURSE-TAKING PATTERN: 1981-82

	Science Course-Taking Pattern			
Field of Study	Concentrator	4-Year College Bound	General Science Student	Non-participant or Limited Participant
Agriculture	2.6	2.1	2.6	1.9
Architecture and Engineering	16.2	10.8	6.3	8.7
Art and Music	.8	6.1	7.3	10.0
Biological and Physical Sciences	9.5	6.4	1.7	1.0
Business	9.4	20.0	26.3	20.1
Communications	1.8	3.6	5.2	4.0
Computer and Information Sciences	10.6	8.5	7.2	9.2
Education	2.8	4.4	4.3	3.2
English and Foreign Languages	2.2	2.7	2.4	1.2
Ethnic and Inter-disciplinary Studies	.1	.2	.1	.2
Health Occupations	3.7	5.4	5.5	2.9
Health Sciences	7.6	6.6	3.8	2.9
Home Economics	0.0	1.4	2.7	3.5
Mathematics	1.4	.7	.7	.3
Philosophy and Religion	.4	.4	.4	.1
Pre-Professional	12.1	7.6	3.6	2.0
Psychology and Social Sciences	3.6	5.8	5.6	5.0
Vocational/Technical Studies	1.8	5.1	8.5	13.5
Other	3.4	4.5	7.9	10.4

CHAPTER 6

CHARACTERISTICS OF STUDENTS EXHIBITING VARIOUS COURSE-TAKING PATTERNS IN VOCATIONAL EDUCATION

The analysis that was performed relating mathematics and science course-taking patterns to selected student characteristics was replicated for the vocational education patterns. The findings of this analysis are summarized in this chapter.

Because intense participation in vocational education was typically associated with less intense advanced study in mathematics and science, it was expected that the characteristics of vocational education concentrators and limited concentrators would resemble those of general level mathematics and science participants and limited/non-participants in the other subject areas. Conversely, the characteristics of vocational education samplers and non-participants were expected to resemble those of mathematics and science college preparatory students (concentrators and 4-year college bound). For the most part, the findings summarized in the following sections support this expectation.

6.1 Socio-demographic Attributes

There were few differences between males and females with respect to vocational education course-taking patterns (see Table 22). There was, however, a difference with respect to vocational education concentration; a slightly higher percentage of females than of males had earned four or more credits in a single vocational education instructional program. Males were overrepresented among the non-participants.

The relationship between the vocational education patterns and SES found in Table 22 was opposite that of mathematics and science. A higher percentage of low SES students as compared with high SES students were concentrators and limited concentrators, while the reverse was found with respect to vocational samplers. Although high SES students represented approximately 25 percent of the total student population, they accounted for nearly 48 percent of the non-participants in vocational education.

TABLE 22: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED VOCATIONAL EDUCATION COURSE-TAKING PATTERNS, BY SEX, SOCIO-ECONOMIC STATUS, AND RACE/ETHNICITY: 1981-82

Vocational Education Course-Taking Pattern	Sex		Socio-economic Status			Race/Ethnicity		
	Male	Female	Low	Middle	High	White	Black	Hispanic/Other
Concentrator	22.8	26.7	34.2	26.8	11.9	25.1	22.2	25.0
	(45.4)[a/]	(54.6)	(34.5)	(53.4)	(12.1)	(73.6)	(10.2)	(16.2)
Limited Concentrator	25.6	25.3	29.3	27.8	17.5	24.3	29.8	27.5
	(49.6)	(50.4)	(28.8)	(54.0)	(17.3)	(69.4)	(13.3)	(17.4)
Sampler	46.4	44.3	38.8	42.3	62.6	46.2	44.1	42.2
	(50.5)	(49.5)	(18.7)	(46.4)	(34.8)	(74.1)	(11.0)	(14.9)
Non-participant	5.3	3.7	2.8	3.1	8.0	4.4	3.9	5.2
	(58.6)	(41.4)	(16.3)	(36.2)	(47.5)	(71.6)	(9.8)	(18.6)

[a/] The figures in parentheses represent the percentage of students within each pattern who possessed the designated characteristic. For example, among vocational education concentrators, 45.4 percent were male and 54.6 percent were female.

Regardless of race/ethnicity, students exhibited about the same vocational education course-taking patterns. This finding differed markedly from that of mathematics and science, where race/ethnicity was strongly linked to course-taking behavior in these subject areas.

Because few private schools had offered vocational training relative to public schools, it is not surprising that public school students were more likely than private school students to have a strong vocational focus or interest (see Table 23). About 54 percent of the public school students were vocational education concentrators or limited concentrators as compared with about 20 percent of the Catholic school students and about 18 percent of the other private school students. On the other hand, students attending Catholic schools were more likely to be vocational samplers than either public school or other private school students. Approximately eight percent of the Catholic school students and four percent of the public school students had earned no vocational credits, as compared with almost one-fourth of the other private school students.

6.2 School Performance and Experiences

The overall grade averages of students differed significantly across the vocational education course-taking patterns (see Table 24). A smaller percentage of concentrators and limited concentrators earned an average grade of B or higher as compared with samplers and non-participants. About 45.6 percent of the non-participants earned an overall grade average of B or higher as compared with about 22 percent of the vocational education concentrators. When the percentages of students who had earned a C average or lower are compared, the reverse pattern was found.

The relationship between the second indicator of student performance, cognitive test scores, and vocational education course-taking patterns is similar to that of grade average (see Table 25). Only 10.4 percent of the concentrators' scores on these tests placed them in the highest quartile compared with nearly 65 percent of the non-participants. The percentage of these students whose test scores fell in the lowest quartile were 28.3 percent and 11.7 percent, respectively.

TABLE 23: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED VOCATIONAL EDUCATION COURSE-TAKING PATTERNS, BY SCHOOL TYPE: 1981-82

Vocational Education Course-Taking Pattern	School Type		
	Public	Catholic	Other Private
Concentrator	26.6	10.6	5.0
Limited Concentrator	27.2	9.5	12.8
Sampler	42.8	71.7	59.8
Non-participant	3.5	8.3	22.4

TABLE 24: PERCENTAGES OF STUDENTS WITH OVERALL GRADE AVERAGES AT SPECIFIED LEVELS, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

Overall Grade Average	Vocational Education Course-Taking Pattern			
	Concentrator	Limited Concentrator	Sampler	Non-participant
A	.2	.2	.3	.5
A-	6.5	5.0	13.6	21.0
B	15.6	13.3	22.0	24.1
B-	28.0	27.8	25.3	26.8
C	31.7	33.5	23.1	16.5
C-	16.2	18.2	12.9	6.4
D	1.9	2.1	2.8	4.8
D-	0.0	0.0	0.0	0.0
F	0.0	0.0	0.0	0.0

TABLE 25: PERCENTAGES OF STUDENTS WHOSE COMPOSITE VOCABULARY, VERBAL, AND MATHEMATICS TEST SCORES FELL INTO THE LOWEST, SECOND, THIRD, AND HIGHEST QUARTILES, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

	Vocational Education Course-Taking Pattern			
Test Score Quartile	Concentrator	Limited Concentrator	Sampler	Non-participant
Lowest Quartile	28.3	26.5	13.7	11.7
Second Quartile	34.7	27.8	17.7	9.1
Third Quartile	26.7	28.1	26.2	14.4
Highest Quartile	10.4	17.7	42.4	64.8

The findings in Table 26 suggest that students who had concentrated in vocational education in high school participated to a lesser extent than other students in many extra-curricular activities. Concentrators and/or limited concentrators were less likely to have participated in varsity athletics and other athletic teams, arts activities (e.g., drama, band, orchestra, chorus, and dance), honorary, subject-matter, and service clubs, student government, and the production of the school newspaper/ yearbook. Not surprisingly, concentrators and limited concentrators were more likely to have participated in vocational education clubs.

6.3 Postsecondary Plans and Aspirations

Table 27 presents the short-term plans of students in each of the four vocational education course-taking patterns. As was expected, the largest single activity that concentrators and limited concentrators indicated would take most of their time the year after graduating from high school was full-time employment. Thus, in all likelihood, their concentration in vocational courses was in preparation for entry into the world of work. The second most commonly cited activity by these students was attending a 4-year college or university; 16 percent of the concentrators and 22 percent of the limited concentrators stated that this activity would occupy the largest share of their time. In contrast, 4-year college attendance was cited by about 49 percent of the vocational education samplers and 64 percent of the non-participants as the activity that would take the largest share of their time the year after graduation. Slightly more than nine percent of the concentrators and eight percent of the limited concentrators indicated that they would take full-time or part-time coursework at a trade or business school.

Given the high percentage of concentrators and limited concentrators who indicated that a full-time job would occupy most of their time the year after high school graduation, it is not surprising that a larger percentage of these students expected to terminate their formal education with high school (see Table 28). Similarly, it is not surprising that a larger percentage of students in the two concentrator categories expected to attend a vocational, trade, or business school for some period of time as compared with samplers and non-participants. Samplers and non-participants were about equally likely to expect to complete college, but a

TABLE 26: PERCENTAGES OF STUDENTS WHO HAD PARTICIPATED IN SPECIFIED EXTRA-CURRICULAR ACTIVITIES, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

Extra-Curricular Activity	Vocational Education Course-Taking Pattern			
	Concentrator	Limited Concentrator	Sampler	Non-participant
Varsity Athletics	25.2	33.1	39.7	43.9
Other Athletic Teams	32.0	42.1	44.2	45.1
Cheerleading, Pep Club	13.6	13.6	14.2	11.2
Debating or Drama	6.5	10.6	16.4	27.8
Band or Orchestra	10.5	10.2	17.7	22.3
Chorus or Dance	14.4	17.0	22.8	29.9
Hobby Clubs	17.8	19.6	19.7	19.7
Honorary Clubs	10.0	8.9	22.3	30.2
School Newspaper/Yearbook	12.1	13.8	22.0	32.5
School Subject-Matter Clubs	18.3	19.1	22.4	29.3
Student Council/Government	10.4	12.8	20.4	24.3
Vocational Education Clubs	41.8	31.2	11.3	4.4
Youth Community Organizations	13.3	14.5	19.2	20.2
Church Activities/Youth Groups	32.2	36.2	38.5	41.1
Junior Achievement	5.0	5.3	5.9	8.2
Service Clubs/Community Service Activities	10.6	12.4	19.4	25.3
Sororities/Fraternities	2.8	2.2	2.8	2.7

TABLE 27: PERCENTAGES OF STUDENTS WHO EXPECTED TO ENGAGE IN SPECIFIED ACTIVITIES FOR THE FIRST YEAR AFTER GRADUATION, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

Activity That Will Take The Largest Share of Time The Year After High School	Vocational Education Course-Taking Pattern			
	Concentrator	Limited Concentrator	Sampler	Non-participant
Working full-time	67.5	39.4	21.0	14.8
Apprentice or on-the-job training	2.8	2.8	1.5	.4
Regular military service (or service academy)	4.8	4.3	3.9	2.8
Full-time homemaker	1.7	1.F	1.0	2.0
Taking courses full-time or part-time at:				
A trade or business school	9.1	8.4	3.9	2.7
A junior or community college:				
Academic courses	8.2	9.5	10.8	7.3
Technical courses	4.9	6.0	3.8	1.1
A 4-year college or university	16.0	22.3	49.3	64.4
Working part-time, but not attending school	2.1	2.0	2.4	1.5
Other (travel, take a break, no plans)	2.9	3.5	2.5	1.2

TABLE 28: PERCENTAGES OF STUDENTS WHO EXPECTED TO OBTAIN SPECIFIED KINDS AND LEVELS OF EDUCATION, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

Educational Expectation	Vocational Education Course-Taking Pattern			
	Concentrator	Limited Concentrator	Sampler	Non-participant
Less than High School Graduation	.5	.4	.6	.9
High School Graduation	29.2	21.8	11.1	8.5
Vocational, Trade or Business School After High School -				
Less Than 2 Years	14.1	11.6	5.8	2.9
Two or More Years	18.0	15.7	7.9	4.6
College - Less than 2 Years	5.4	5.5	2.8	2.0
College - 2 or More Years	16.1	17.5	14.9	6.6
College Completion - 4 or 5 Year Degree	11.2	19.2	31.4	30.5
Master's Degree or Equivalent	4.9	6.1	15.5	26.2
Ph.D., M.D., or Other Advanced Professional Degree	2.5	4.5	11.9	18.5

larger percentage of non-participants expected to attain an advanced degree.

Table 29 relates the expected jobs or occupations of students when [illegible] years old to their vocational education course-taking patterns. Overall, the occupational aspirations of students exhibiting the different patterns of participation were fairly similar. There were, however, some exceptions. Concentrators were more likely than others to indicate that their occupation at age 30 would be clerical or that they would be craftsmen. Furthermore, there is a steady increase in the percentage of students who indicated that they would be a professional by age 30 as one moves from intense concentration to non-participation in vocational education courses. For example, non-participants were three times as likely as concentrators to state that they expected to be in a professional position at age 30.

As the findings in Table 30 indicate, there were few substantial differences reported by students in the different vocational education participation categories with respect to their planned field of study at a college or university. Exceptions to this finding included business, pre-professional, and vocational/technical studies. Approximately 32 percent of the vocational education concentrators indicated that they planned to study business as compared with about 18 percent of the samplers and 12 percent of the non-participants. A smaller percentage of the concentrators and limited concentrators stated that they planned to enter a pre-professional curriculum as compared with the other classifications of the students. Needless to say, concentration in vocational education during high school was related to plans to pursue vocational/technical studies in college.

Because a possible extension of high school vocational training is attendance at a trade or vocational school, students were asked what specific fields of study they would pursue at such a school. The findings relating their responses to this inquiry to course-taking patterns are presented in Table 31.

With the exception of vocational education concentrators, the largest percentage of students in each of the course-taking categories stated that they had no plans to attend a trade or vocational school. However, this was stated more frequently by samplers and non-participants (44.1 percent and

TABLE 29: PERCENTAGES OF STUDENTS WHO EXPECTED TO HOLD SPECIFIED JOBS OR OCCUPATIONS WHEN 30 YEARS OLD, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

	Vocation Education Course-Taken Pattern			
Occupation	Concentrator	Limited Concentrator	Sampler	Non-participant
Clerical	19.6	7.7	3.9	1.5
Craftsman	13.3	8.3	3.9	2.8
Farmer, Farm Manager	3.8	2.4	.8	.9
Homemaker	3.6	2.7	2.1	1.5
Laborer	1.8	1.5	1.4	.9
Manager, Administrator	7.2	7.2	8.9	6.8
Military	2.0	2.6	2.2	2.1
Operative	5.0	5.7	1.9	3.1
Professional - No Advanced Degree	16.4	24.7	33.2	37.4
Professional - Advanced Degree	5.0	6.2	14.6	22.5
Proprietor or Owner	4.5	5.7	4.1	4.2
Protective Service	1.5	2.5	1.9	1.1
Sales	1.2	2.5	1.9	1.0
School Teacher	2.2	3.2	4.2	3.6
Service	5.1	6.0	2.7	1.4
Technical	9.1	12.3	11.8	9.4
Not Working	.8	.8	.5	0.0

TABLE 30: PERCENTAGES OF COLLEGE-BOUND STUDENTS WHO PLANNED TO ENROLL IN SPECIFIED FIELDS OF STUDY, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

Field of Study	Vocational Education Course-Taking Pattern			
	Concentrator	Limited Concentrator	Sampler	Non-participant
Agriculture	3.6	3.2	1.6	1.5
Architecture and Engineering	10.2	8.4	11.5	14.9
Art and Music	4.7	5.9	7.2	7.0
Biological and Physical Sciences	1.1	2.3	4.7	7.7
Business	32.3	21.9	17.5	11.8
Communications	1.5	2.2	4.3	5.8
Computer and Information Sciences	7.6	9.5	8.1	7.1
Education	3.4	3.9	4.5	2.6
English and Foreign Languages	.8	1.2	3.2	5.2
Ethnic and inter-disciplinary Studies	0.0	.2	.1	.3
Health Occupations	4.1	6.1	5.0	2.5
Health Sciences	2.9	5.6	6.1	3.0
Home Economics	2.9	3.8	1.0	0.0
Mathematics	.2	.4	1.1	.6
Philosophy and Religion	0.0	.2	.5	1.2
Pre-Professional	1.5	3.0	8.4	12.1
Psychology and Social Sciences	2.8	4.4	6.5	8.3
Vocational/Technical Studies	13.2	9.5	3.8	2.8
Other	7.2	8.6	5.2	5.6

TABLE 31: PERCENTAGES OF STUDENTS WHO EXPECTED TO TRAIN IN SPECIFIED FIELDS AT A TRADE OR VOCATIONAL SCHOOL, BY VOCATIONAL EDUCATION COURSE-TAKING PATTERN: 1981-82

	Vocational Education Course Taking Pattern			
Field of Study	Concentrator	Limited Concentrator	Sampler	Non-participant
Agriculture	3.8	3.2	1.6	1.7
Auto Mechanics	7.6	5.6	3.0	3.5
Commercial Arts	2.5	3.7	4.4	6.4
Computer Programming or Computer Operations	9.0	11.6	11.3	8.4
Construction Trades	5.0	4.4	3.1	2.2
Plumbing	.4	.4	.5	.2
Cosmetology, Hairdressing, or Barbering	5.2	5.3	2.4	2.2
Drafting	2.3	2.7	1.8	1.0
Electronics	2.9	3.5	3.0	3.9
Home Economics	2.0	3.1	1.3	0.0
Machine Shop	2.4	.9	.6	.3
Medical or Dental Assisting/Practical Nursing	4.9	8.4	7.4	4.5
Quantity Food Occupations	.7	.9	.5	.4
Sales or Merchandising	2.7	3.7	3.2	1.6
Secretarial, Stenographic, Typing, or Other Office Work	18.4	6.4	3.3	1.5
Welding	3.2	3.1	.9	.3
Aviation	1.0	1.9	2.6	3.4
Refrigeration	.4	.4	.3	0.0
Other	7.2	5.8	4.9	5.1
Don't Plan To Go To Trade or Vocational School	18.4	25.1	44.1	53.6

53.6 percent, respectively) than by concentrators or limited concentrators (18.4 percent and 25.1 percent, respectively).

Among the concentrators, the most frequently cited field of study at a trade or vocational school was secretarial, stenographic, typing, or other office work. This was followed by computer programming or computer operations and auto mechanics. Computer programming or computer operations was identified by the largest percentage of limited concentrators, samplers, non-participants as the field they would most likely study at a trade or vocational school. Among the limited concentrators, medical or dental assisting/ practical nursing were the second most cited fields of study. About six percent of the non-participants identified commercial arts as the field that they would study at this type of school.

CHAPTER 7

CHARACTERISTICS OF STUDENTS EXHIBITING VARIOUS COURSE-TAKING PATTERNS IN COMPUTER SCIENCE

Students were grouped according to whether they had or had not earned any credit in computer studies over their high school careers. These two groups were then compared on a number of characteristics. The results are presented below.

7.1 Sociodemographic Attributes

Table 32 relates computer science participation to several student characteristics. A minority of both males and females had earned computer science credit (14 percent and 11 percent, respectively). Females were slightly underrepresented and males slightly overrepresented among those students earning such credit.

Participation in computer science was related to students' SES and race/ethnicity. High SES students were twice as likely as low SES students to have earned computer science credit (17.4 percent versus 8.4 percent, respectively). White students were more likely to have earned computer science credit than either black or Hispanic/other students. White students represented about 73 percent of the total population of high school students, yet they accounted for about 80 percent of those students who had earned computer science credit. In contrast, students classified as Hispanic/other represented about 16 percent of the student population and accounted for 10 percent of the computer science participants.

Students who attended other (non-Catholic) private schools were less likely to have earned credit in computer science (see Table 33). There was no significant difference in the participation of public and Catholic school students.

7.2 School Performance and Experiences

As was the case with respect to more intense participation in mathematics and science, student participation in computer science was related to

TABLE 12: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED COMPUTER SCIENCE COURSE-TAKING PATTERNS, BY SEX, SOCIO-ECONOMIC STATUS, AND RACE/ETHNICITY: 1981-82

Computer Science Course-Taking Pattern	Sex		Socio-economic Status			Race/Ethnicity		
	Male	Female	Low	Middle	High	White	Black	Hispanic/Other
Participant	13.6	11.4	8.4	12.4	17.4	13.8	10.5	8.0
	(53.8)[a]	(46.3)	(16.7)	(48.7)	(34.6)	(80.2)	(9.5)	(10.3)
Non-participant	86.4	88.6	91.6	87.6	82.7	86.2	89.5	92.0
	(48.7)	(51.3)	(26.3)	(49.8)	(23.9)	(71.6)	(11.6)	(16.9)

[a] The figures in parentheses represent the percentage of students within each pattern who possessed the designated characteristic. For example, among computer science participants, 53.8 percent were male and 46.3 percent were female.

TABLE 33: PERCENTAGES OF STUDENTS WHO EXHIBITED SPECIFIED COMPUTER SCIENCE COURSE-TAKING PATTERNS, BY SCHOOL TYPE: 1981-82

Computer Science Course-Taking Pattern	School Type		
	Public	Catholic	Other Private
Participant	12.5	14.3	8.7
Non-participant	87.5	85.7	91.3

various indicators of school performance. These findings are not surprising given the strong association between computer science participation and college preparatory levels of participation in these other subject areas. Computer science participants had higher overall grade averages (see Table 34) and scored higher on tests of cognitive ability than did non-participants (see Table 35). For example, about 42 percent of the participants had earned an average grade of B or higher as compared with about 26 percent of the non-participants. Computer science participants' test scores were highly skewed towards the two upper quartiles, while non-participants' scores were about evenly distrituted across all test score quartiles.

For the most part, the extra-curricular activities of students participating in computer science did not differ significantly from those of non-participants (see Table 36). Exceptions included varsity athletics and other athletic teams, chorus or dance, honorary clubs, and vocational education clubs. Participants were more likely to have taken part in athletics and honorary clubs, and were less likely to have taken part in chorus or dance and vocational education clubs.

7.3 Postsecondary Plans and Aspirations

With some exceptions, students who had participated in computer science did not differ significantly from those who had not participated in this area of study with respect to their immediate post-graduation plans (see Table 37). Students who had earned some computer science credit were more likely than non-participants to plan on attending a 4-year college or university (52 percent versus 32.2 percent, respectively). A slightly higher percentage of participants expected to take technical courses at a community or junior college than did non-participants (6.6 percent versus 4.2 percent). Moreover, participants were less likely to plan on attending a trade or business school. In addition, the percentage of participants who planned to work full-time the year after graduation was significantly smaller than that of non-participants (19.5 percent versus 33.8 percent).

When asked about the kind and level of education that they expected to attain, differences were found between participants and non-participants (see Table 38). Specifically, participants were more likely to indicate that they expected to complete college or attain an advanced degree, while

TABLE 34: PERCENTAGES OF STUDENTS WITH OVERALL GRADE AVERAGES AT SPECIFIED LEVELS, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-82

Overall Grade Average	Computer Science Course Taking Pattern: Participant	Non-participant
A	.7	.2
A-	18.7	8.6
B	22.7	17.6
B-	27.6	26.6
C	21.6	28.5
C-	8.0	15.8
D	.8	2.7
D-	0.0	0.0
F	0.0	0.0

TABLE 35: PERCENTAGES OF STUDENTS WHOSE COMPOSITE VOCABULARY, VERBAL, AND MATHEMATICS TEST SCORES FELL INTO THE LOWEST, SECOND, THIRD, AND HIGHEST QUARTILES, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-82

Test Score Quartile	Computer Science Course-Taking Pattern	
	Participant	Non-participant
Lowest Quartile	9.5	22.0
Second Quartile	15.1	25.4
Third Quartile	25.2	26.5
Highest Quartile	50.2	26.1

TABLE 36: PERCENTAGES OF STUDENTS WHO HAD PARTICIPATED IN SPECIFIED EXTRA-CURRICULAR ACTIVITIES, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-82

	Computer Science Course-Taking Pattern	
Extra-Curricular Activity	Participant	Non-participant
Varsity Athletics	38.9	34.0
Other Athletic Teams	44.2	40.1
Cheerleading, Pep Club	12.2	14.0
Debating or Drama	11.7	13.1
Band or Orchestra	14.9	14.1
Chorus or Dance	15.3	20.2
Hobby Clubs	19.5	19.2
Honorary Clubs	23.9	15.0
School Newspaper/Yearbook	18.8	17.8
School Subject-Matter Clubs	21.5	20.8
Student Council/Government	16.3	16.1
Vocational Education Clubs	16.9	24.7
Youth Community Organizations	16.9	16.5
Church Activities/Youth Groups	34.4	36.8
Junior Achievement	5.0	5.7
Service Clubs/Community Service Activities	17.8	15.4
Sororities/Fraternities	2.3	2.7

TABLE 37: PERCENTAGES OF STUDENTS WHO EXPECTED TO ENGAGE IN SPECIFIED ACTIVITIES FOR THE FIRST YEAR AFTER GRADUATION, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-82

Activity That Will Take The Largest Share of Time The Year After High School	Computer Science Course-Taking Pattern	
	Participant	Non-participant
Working full-time	19.5	33.8
Apprentice or on-the-job training	1.4	2.2
Regular military service (or service academy)	3.0	4.4
Full-time homemaker	.5	1.6
Taking courses full-time or part-time at:		
A trade or business school	4.3	6.6
A junior or community college:		
Academic courses	9.0	9.8
Technical courses	6.6	4.2
A 4-year college or university	52.0	32.2
Working part-time, but not attending school	1.7	2.5
Other (travel, take a break, no plans)	1.9	3.0

non-participants were more likely to indicate that they expected to study for some period of time at a vocational, trade or business school. Students who had earned no computer science credit were three times as likely as participants to identify high school graduation as the highest level of education that they expected to complete.

Table 39 summarizes the occupational aspirations of computer science participants and non-participants. In general, the aspirations of these two groups were similar; however, a few differences were found. A larger percentage of participants planned to be a professional or aspired to technical occupations such as a computer programmer. In comparison with participants, non-participants envisioned themselves more as a craftsman or operator (e.g., meat cutter, assembler, machine operator, welder, taxicab, bus, or truck by age 30.

The findings presented in Table 40 relate participation in computer science to students' planned field of study at a college or university. With few exceptions, participation in computer science was unrelated to these plans. Participants were more likely than non-participants, however, to indicate that they planned to study architecture and engineering. Moreover, as would be expected, participants were three times as likely as non-participants to plan to study computer and information science.

TABLE 38: PERCENTAGES OF STUDENTS WHO EXPECTED TO OBTAIN SPECIFIED KINDS AND LEVELS OF EDUCATION, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-82

Educational Expectation	Computer Science Course-Taking Pattern: Participant	Non-participant
Less than High School Graduation	.2	.6
High School Graduation	6.5	19.9
Vocational, Trade or Business School After High School-		
Less Than 2 Years	4.2	8.9
Two or More Years	8.1	12.8
College - Less than 2 Years	2.9	3.0
College - 2 or More Years	16.0	15.4
College Completion - 4 or 5 Year Degree	35.5	21.5
Master's Degree or Equivalent	15.9	10.3
Ph.D., M.D., or Other Advanced Professional Degree	10.7	7.6

TABLE 39: PERCENTAGES OF STUDENTS WHO EXPECTED TO HOLD SPECIFIED JOBS OR OCCUPATIONS WHEN 30 YEARS OLD, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-1982

	Computer Science Course-Taking Pattern	
Occupation	Participant	Non-participant
Clerical	7.0	8.9
Craftsman	2.9	7.9
Farmer, Farm Manager	1.0	2.1
Homemaker	1.9	2.7
Laborer	.3	1.7
Manager, Administrator	9.1	7.8
Military	1.9	2.3
Operative	.6	3.6
Professional - No Advanced Degree	31.0	26.4
Professional - Advanced Degree	12.8	9.5
Proprietor or Owner	3.1	4.8
Protective Service	1.0	2.1
Sales	1.5	1.9
School Teacher	2.9	3.5
Service	1.7	4.4
Technical	21.0	9.7
Not Working	.3	.7

TABLE 40: PERCENTAGES OF COLLEGE-BOUND STUDENTS WHO PLANNED TO ENROLL IN SPECIFIED FIELDS OF STUDY, BY COMPUTER SCIENCE COURSE-TAKING PATTERN: 1981-82

Field of Study	Computer Science Course-Taking Pattern	
	Participant	Non-participant
Agriculture	1.5	2.5
Architecture and Engineering	13.3	10.1
Art and Music	2.2	7.1
Biological and Physical Sciences	4.5	3.3
Business	24.0	20.8
Communications	1.5	3.6
Computer and Information Sciences	19.2	6.3
Education	3.3	4.1
English and Foreign Languages	2.0	2.4
Ethnic and Inter-disciplinary Studies	.2	.1
Health Occupations	2.5	5.4
Health Sciences	4.7	5.2
Home Economics	.9	2.2
Mathematics	1.0	.7
Philosophy and Religion	.1	.4
Pre-Professional	6.0	5.8
Psychology and Social Sciences	4.5	5.5
Vocational/Technical Studies	5.3	7.3
Other	3.3	7.0

CHAPTER 8

CHARACTERISTICS OF GENERAL EDUCATION STUDENTS

The findings of the analyses performed to determine the characteristics of general education students are reported in this chapter. As discussed in Chapter 2, the analyses of general education students relied upon the definitions of student program participation established by the students themselves. Nationwide, about 35 percent of secondary school students defined their high school program in this way. For comparison purposes, the characteristics of students participating in all other types of programs were aggregated and analyzed. Tables 41 through 49 present the results of these analyses.

8.1 Socio-demographic Attributes

A larger percentage of males (38.4 percent) than of females (32 percent) had participated in a general education program (see Table 41). General education students were also more likely to come from a lower socio-economic background than were students in other programs. High SES students were the least likely to have participated in a general education program and were underrepresented in this program relative to their representation in the total student population.

There was no difference in the percentage of white and black students who had participated in a general education program. Moreover, each was represented within this type of program about equal to their representation in the student population. While the percentage of Hispanic/other students among the population of general education students equalled their representation in the total student population, a larger percentage of these students had participated in this type of program than had either white or black students.

As the findings in Table 42 suggest, general education participation was related to the type of school attended. Public school students (36.7 percent) were more likely than Catholic school students (22.2 percent) or other private school students (21.2 percent) to have participated in a general education program.

TABLE 41: PERCENTAGES OF STUDENTS WHO TOOK A GENERAL EDUCATION PROGRAM, BY SEX, SOCIO-ECONOMIC STATUS, AND RACE/ETHNICITY: 1981-82

General Education Students	Sex		Socio-economic Status			Race/Ethnicity		
	Male	Female	Low	Middle	High	White	Black	Hispanic/Other
General Education Students	38.4 (53.4)[a/]	32.0 (46.6)	41.2 (29.5)	35.7 (50.6)	27.6 (19.9)	34.5 (72.3)	34.4 (11.1)	38.7 (16.5)
All Other Students	61.6 (46.4)	68.0 (53.6)	58.8 (22.7)	64.3 (49.2)	72.4 (28.1)	65.5 (74.3)	65.6 (11.5)	61.3 (14.2)

a/ The figures in parentheses represent the percentage of students within each pattern who possessed the designated characteristic. For example, among general education students, 53.4 percent were male and 46.6 percent were female.

TABLE 42: PERCENTAGES OF STUDENTS WHO TOOK A GENERAL EDUCATION PROGRAM, BY SCHOOL TYPE: 1981-82

	School Type		
	Public	Catholic	Other Private
General Education Students	36.7	22.2	21.2
All Other Students	63.3	77.8	78.8

8.2 School Performance and Experiences

General education students did more poorly on the standard measures of student performance--grade average and cognitive test scores--than did students in other high school programs (see Tables 43 and 44). Only 19 percent of the general education students earned a B average or higher as compared with about 34 percent of the other students. Conversely, 55 percent of the general education students had a C average or lower, as compared with 38 percent of the other students.

Students in a general education program were less than half as likely as other students to have received scores that placed in the highest cognitive test quartile (15.8 percent versus 36.5 percent, respectively). In contrast, about one-fourth of the general education students had scored in the lowest quartile while less than one-fifth of the students in other programs had similar scores on tests designed to measure verbal, mathematics, and vocabulary abilities.

General education students differed from other students with respect to their participation in many extra-curricular activities (see Table 45). For example, they were less likely to have participated in varsity athletics, honorary clubs, production of the school newspaper/yearbook, school subject-matter clubs, and student government. They were also less likely to have been involved in youth community organizations, service clubs, and community service activities. Thus, their lower participation rates in these activities resemble those associated with general or limited/non-participants in mathematics and science.

8.3 Postsecondary Plans and Aspirations

When students were asked about the activity that would take the largest share of their time the year after high school graduation, general education students indicated more often than other students that they would work full-time (39.9 percent versus 27.7 percent) (see Table 46). These two categories of students also differed with respect to expected attendance at a 4-year college or university; general education students were less likely to indicate that their short-term plans included attending a 4-year college or university.

TABLE 43: PERCENTAGES OF STUDENTS IN A GENERAL EDUCATION PROGRAM WITH OVERALL GRADE AVERAGES AT SPECIFIED LEVELS: 1981-82

Overall Grade Average	General Education Students	All Other Students
A	.2	.3
A-	4.9	13.0
B	14.1	21.0
B-	25.8	27.3
C	32.8	24.8
C-	19.5	11.7
D	2.8	1.9
D-	0.0	0.0
F	0.0	0.0

TABLE 44: PERCENTAGES OF STUDENTS IN A GENERAL EDUCATION PROGRAM WHOSE COMPOSITE VOCABULARY, VERBAL, AND MATHEMATICS TEST SCORES FELL INTO THE LOWEST, SECOND, THIRD, AND HIGHEST QUARTILES: 1981-82

Test Score Quartile	General Education Students	All Other Students
Lowest Quartile	24.7	18.0
Second Quartile	30.6	20.5
Third Quartile	29.0	25.0
Highest Quartile	15.8	36.5

TABLE 45: PERCENTAGES OF STUDENTS IN A GENERAL EDUCATION PROGRAM WHO HAD PARTICIPATED IN SPECIFIED EXTRA-CURRICULAR ACTIVITIES: 1981-82

Extra-Curricular Activity	General Education Students	All Other Students
Varsity Athletics	31.1	36.6
Other Athletic Teams	39.8	41.2
Cheerleading, Pep Club	12.7	14.4
Debating or Drama	11.4	13.8
Band or Orchestra	13.2	14.9
Chorus or Dance	19.5	19.5
Hobby Clubs	10.4	18.6
Honorary Clubs	8.4	20.4
School Newspaper/Yearbook	13.9	20.1
School Subject-Matter Clubs	17.1	22.8
Student Council/Government	10.9	19.1
Vocational Education Clubs	22.3	24.4
Youth Community Organizations	13.4	18.4
Church Activities/Youth Groups	33.1	38.5
Junior Achievement	5.4	5.8
Service Clubs/Community Service Activities	12.2	17.6
Sororities/Fraternities	2.6	2.9

TABLE 46: PERCENTAGES OF STUDENTS IN A GENERAL EDUCATION PROGRAM WHO EXPECTED TO ENGAGE IN SPECIFIED ACTIVITIES FOR THE FIRST YEAR AFTER GRADUATION: 1981-82

Activity That Will Take The Largest Share of Time The Year After High School	General Education Students	All Other Students
Working full-time	39.8	27.7
Apprentice or on-the-job training	2.5	1.9
Regular military service (or service academy)	5.4	3.5
Full-time homemaker	2.0	1.1
Taking courses full-time or part-time at:		
A trade or business school	7.1	5.7
A junior or community college:		
Academic courses	9.4	9.8
Technical courses	4.6	4.4
A 4-year college or university	21.9	41.9
Working part-time, but not attending school	3.2	1.7
Other (travel, take a break, no plans)	4.1	2.2

A large percentage of students in all types of high school programs expected that college would play some role in their future education plans (see Table 47). However, a lower percentage of the general education students expected to complete college or to attain an advanced degree. On the other hand, general education students were more likely than other students to expect to attend a vocational, trade, or business school for some period of time. General education students were also more likely than other students to expect high school to be the culmination of their formal education (25.6 percent versus 14.1 percent).

The findings in Table 48 indicate that the job/occupational expectations of general education students were, for the most part, very similar to those of other students. The largest differences were with respect to professional occupations. A smaller percentage of general education students (29.6 percent) than other students (40.8 percent) expected to hold a professional occupation by age 30.

In general, the planned fields of study of college bound general education students were similar to those of other students (see Table 49). Business was the most popular field for each of these groups. Nevertheless, several interesting differences were found. General education students were less likely than other students to plan to study architecture and engineering or to engage in pre-professional studies. A larger percentage of the general education students expressed plans to pursue art and music.

TABLE 47: PERCENTAGES OF STUDENTS IN A GENERAL EDUCATION PROGRAM WHO EXPECTED TO OBTAIN SPECIFIED KINDS AND LEVELS OF EDUCATION: 1981-82

Educational Expectation	General Education Students	All Other Students
Less than High School Graduation	.7	.5
High School Graduation	25.6	14.1
Vocational, Trade or Business School After High School-		
Less Than 2 Years	9.8	7.4
Two or More Years	15.6	10.5
College - Less than 2 Years	3.9	2.6
College - 2 or More Years	15.5	15.5
College Completion - 4 or 5 Year Degree	18.3	26.0
Master's Degree or Equivalent	6.3	13.5
Ph.D., M.D., or Other Advanced Professional Degree	4.4	10.0

TABLE 48: PERCENTAGES OF STUDENTS IN A GENERAL EDUCATION PROGRAM WHO EXPECTED TO HOLD SPECIFIED JOBS OR OCCUPATIONS WHEN 30 YEARS OLD: 1981-1982

Occupation	General Education Students	All Other Students
Clerical	6.9	9.6
Craftsman	9.5	6.1
Farmer, Farm Manager	2.3	1.8
Homemaker	3.7	2.0
Laborer	2.6	.9
Manager, Administrator	7.9	8.0
Military	2.9	1.8
Operative	4.1	2.7
Professional - No Advanced Degree	24.0	28.6
Professional - Advanced Degree	5.6	12.2
Proprietor or Owner	5.4	4.2
Protective Service	2.7	1.5
Sales	2.4	1.6
School Teacher	3.6	3.3
Service	5.1	3.5
Technical	10.4	11.6
Not Working	.9	.5

TABLE 49: PERCENTAGES OF COLLEGE-BOUND STUDENTS IN A GENERAL EDUCATION PROGRAM WHO PLANNED TO ENROLL IN SPECIFIED FIELDS OF STUDY: 1981-82

Field of Study	General Education Students	All Other Students
Agriculture	3.1	2.1
Architecture and Engineering	8.5	11.7
Art and Music	8.8	5.1
Biological and Physical Sciences	2.2	4.2
Business	20.6	21.6
Communications	2.7	3.6
Computer and Information Sciences	.9	8.3
Education	5.1	3.5
English and Foreign Languages	2.3	2.4
Ethnic and Inter-disciplinary Studies	.1	.2
Health Occupations	5.9	4.5
Health Sciences	4.0	5.7
Home Economics	2.5	1.7
Mathematics	.7	.8
Philosophy and Religion	.1	.5
Pre-Professional	2.9	7.3
Psychology and Social Sciences	5.5	5.3
Vocational/Technical Studies	8.6	6.3
Other	8.7	5.5

TECHNICAL APPENDIX

A. SOURCES OF THE DATA

Data for the analysis of course-taking patterns in mathematics, science, vocational education, computer science, and general education came from the sophomore cohort of the High School and Beyond (HS&B) Study sponsored by NCES. Several components of the HS&B First Follow-up Survey provided the data used in the analysis. The 1982 HS&B transcripts collection provided data which were used to define course-taking patterns. The data on the characteristics of secondary school students came from the responses to the school and student questionnaires administered during the HS&B Base Year and First Follow-up surveys.

All of the HS&B samples were designed to provide national estimates. The sample designs of these surveys are described in the following sections.[1]

A.1 High School and Beyond Sample Designs

A.1.1 Base Year Survey Sample Design

Base year data for the HS&B study were collected in 1980. A highly stratified, two-stage probability sample was used to select over 58,000 high

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1/ More detailed information on the sample designs of the HS&B surveys as well as information on their data collection procedures and other survey features is provided in:

C. Jones, S. Knight, M. Butz, I. Crawford, and B. Stephenson, High School and Beyond Transcripts Survey (1982): Data File User's Manual. Chicago, Illinois: National Opinion Research Center, 1983.

C. Jones, M. Clarke, H. McWilliams, I. Crawford, B. Stephenson, and R. Tourangeau, High School and Beyond 1980 Sophomore Cohort First Follow-up (1982): Data File User's Manual. National Center for Education Statistics (NCES 83-214), 1983.

C. Jones, M. Frankel, R. Tourangeau, H. McWilliams, F. O'Brien, High School and Beyond First Follow-up Sample Design Report. Chicago, Illinois: National Opinion Research Center, 1983.

school students (over 28,000 seniors and over 30,000 sophomores) from over 1,000 public and private secondary schools. Over 1,000 schools were selected during the first stage of the design with a probability proportional to the estimated enrollment in their 10th and 12th grades.[2] During the second stage of sampling, 36 seniors and 36 sophomores were selected in each school, except in those schools with fewer than 36 seniors or 36 sophomores. In the latter schools, all eligible students were drawn in the sample. This report utilizes only data from the sophomore cohort members.

A.1.2 First Follow-up Survey Sample Design

The HS&B First Follow-up Survey sample design retained the essential features of the 1980 Base Year design. That is, it was a multi-stage, stratified, probability sample with schools selected during the first stage of sampling, and students selected during stage two. Listed below are the important features of the 1982 First Follow-up sample design:

- All schools selected as part of the Base Year Survey were contacted for participation in the First Follow-Up Survey unless they had no 1980 sophomores, had closed, or had merged with other schools in the base year sample.

- 1980 sophomores still enrolled in their 1980 schools were retained with certainty, resulting in approximately 30,000 1980 sophomores being included in the sample.

- 1980 sophomore cohort students who were no longer attending their base year schools (i.e., dropouts, early graduates, and those who had transferred as individuals to a new school) were subsampled.

2/ This selection criterion was not used uniformly across all strata in the sample design. In certain sample strata (e.g., schools with large minority enrollments), study requirements resulted in an oversampling of schools. For more information on the Base Year Survey sample design, see M. Frankel, L. Luane, D. Buonanno, and R. Tourangeau, Sample Design Report. Chicago, Illinois: National Opinion Research Center, 1981.

A.1.3 Transcripts Survey Sample Design

The sample for the HS&B Transcripts Survey was selected from among the 1980 sophomores who were eligible for the First Follow-up Survey. Prior to selecting the sample, 1980 sophomores were stratified according to a number of student and school-level characteristics. The strata were partitioned into one of two major groups with different student selection probabilities: one contained policy-relevant subgroups (e.g., students from private schools, base year nonrespondents, high achievement blacks, and high achievement Hispanics), and the other contained all of the remaining sophomore subgroupings (e.g., other blacks, other Hispanics, and all other students).

All students in the policy-relevant subgroups were selected with certainty, resulting in 12,987 students being included in the survey sample. An additional 5,440 sophomores were selected from the remaining subgroups, with a selection probability equal to approximately .32. A total of 18,427 members of the 1980 sophomore cohort were selected for participation in the HS&B Transcripts Survey.

Ninety-one percent of the schools responded to the request for student transcripts. Schools provided 15,941 (88 percent) of the 18,152 transcripts requested (excluding the non-sampled co-twins).

The case weights for the transcripts data were adjusted to take into account differential rates of response for a number of school types and student statuses. The average nonresponse adjustment factor was 1.13.[3]

B. ESTIMATION PROCEDURES

The goals of the analysis were to identify: (1) mathematics, science, vocational education, computer science, and general education course-taking patterns in U.S. secondary schools, and (2) the characteristics of students that are related to patterns of participation in these subject areas.

3/ For more information on this adjustment see High School and Beyond Transcripts Survey (1982): Data File User's Manual, pp. 12-17.

Since these goals were directed toward understanding course-taking patterns of U.S. secondary school students, estimates were expanded to represent all or some portion of the national population of students. The procedures used to produce the estimates found in the study tables are described below.

B.1 Estimates of Student Course-Taking Patterns

The 1982 HS&B Transcript Survey was the source of data used to estimate the number and percentage of students exhibiting various course-taking patterns. As described in Chapter 2, course-taking patterns in mathematics, science, vocational education, and computer science, were operationally defined, totally or in part, by the number of credits a student earned in certain courses.[4] Only credits earned in courses where a student received a passing grade were tabulated to establish these patterns.[5]

In addition to the credits earned in a course, vocational education course-taking patterns were based on the number of vocational education instructional programs in which credits were earned. When calculating each of these, courses that were failed and/or that did not result in credits being earned (e.g., courses audited) were deleted.

Estimates of the number and percentage of students exhibiting various course-taking patterns in the subject areas were expanded to represent the population of secondary school students. However, the estimates apply only to the estimated 3,260,382 1980 sophomores who were enrolled in school in the Spring of 1982, or had graduated early. The estimates do not apply to those 1980 sophomores who dropped out of school prior to the Spring of 1982.

4/ Since the credit systems of schools vary considerably, course credits in the HS&B Transcript Survey data file were standardized using the procedures of the National Longitudinal Survey of Labor Force Behavior. The standardized credits (SCC) in the data file are defined by:

$$SSC = CC/SCO$$

Where CC = Course credit earned by the student
SCO = Number of credits offered for completion of a one-year course in a particular school.

5/ If it was not possible to determine the number of credits associated with a particular course, that course was not included in the analysis.

Dropouts were excluded from the analysis because of the problems they create for the interpretation of the course-taking patterns. With dropouts removed from consideration, all patterns are representative of the course-taking behavior of those students who had completed high school or who had been enrolled in high school for four years. That is, a student's placement within a pattern is not contingent upon the number of years he or she has attended school, but on the course-taking behavior exhibited while a student.

C. STANDARD ERRORS

Each of the 1982 HS&B samples represent only one of many that could have been selected using the same sample design specifications. Estimates derived from these different samples would vary. Standard errors for the estimated totals and percentages measure the precision of these estimates, i.e., the variation of all the estimates around the theoretical, complete-coverage values. The standard errors, together with the sample estimates, may be used to define confidence intervals, i.e., ranges that would include the comparable complete-coverage value for a specified percentage of all possible samples. For example, the complete-coverage value would be included in the range from two standard errors above to two standard errors below the estimate for about 95 percent of all possible samples.

No standard errors were reported for the estimates presented in the tables in Chapters 3 through 8. Methods for approximating the standard errors of the estimated totals and percentages presented in the tables are described below.

All of the estimates of the number and percentage of student course-taking patterns and other student characteristics were based on sample data. The standard error (SE) of a percentage (p) estimated from a simple random sample (SRS) of n students from the total population of secondary school students (N) is approximately:

$$SE_{(p)} = DEFT\sqrt{(1 - n/N)\ (p)\ (100-p)/n}$$

DEFT is a correction factor used to compensate for the effect of the sample design. Since the students in the 1982 HS&B study were selected using a disproportionate stratified sample design, simple random sampling formulas will underestimate the variance and standard errors of simple statistics such as percentages. For the student-based estimates reported in the tables, the DEFT correction factor is 2.0.[6]

The standard error of the estimated number of students with varying characteristics is computed by multiplying the standard error of the estimated proportion ($SE_p/100$) by the number of students in the population of U.S. secondary school students or by the number of students in a specific subclass of students (e.g., high SES students).

Since different tables in the report are based on different subsamples of students, it is important that the appropriate sample (n) and population (N) sizes be used in calculating these approximations of the standard errors.

Estimates reported in Tables 1 through 49 were based on the responses of those students participating in the transcript survey who were still attending their original base year school (or who had graduated early). The total and subclass sample sizes (n) on which these estimates were based are reported in Table A.1. This table also contains the weighted N for each subclass.

6/ Exact standard errors calculated by the method of Balanced Repeated Replication are available through NCES.

Table A.1: Unweighted and Weighted Numbers of Students, for the Major Subclasses Used in the Student Course-Taking Patterns Tables[a]

	n	N
Total Students	13,946	3,260,382
Mathematics Course-taking Patterns		
Concentrators	1,573	280,383
4-Year College Bound	5,400	1,194,149
General Mathematics Students	6,371	1,632,021
Limited Participants or Non-participants	602	151,924
Science Course-taking Patterns		
Concentrators	1,481	303,543
4-Year College Bound	4,148	903,596
General Science Students	6,312	1,538,554
Limited Participants or Non-participants	2,005	513,255
Vocational Education Course-taking Patterns		
Concentrators	2,996	806,605
Limited Concentrators	3,234	829,477
Samplers	6,893	1,476,712
Non-participants	823	146,188
Computer Science Course-taking Patterns		
Participants	1,825	408,012
Non-participants	12,121	2,848,296
General Education		
General Education Students	4,412	1,092,308
All Other Students	9,063	2,016,786

a/ In some cases, these numbers do not match those on which the table estimates were based because of missing data. Consequently, approximations of the standard errors associated with the recorded estimates calculated using these numbers may be slightly biased. Exact standard errors of all estimates are available from NCES.

Table A.1: Unweighted and Weighted Numbers of Students, for the Major Subclasses Used in the Student Course-Taking Patterns Tables[a] (Continued)

	n	N
Sex		
Male	6,914	1,607,686
Female	7,032	1,649,728
Socio-economic Status		
Low	3,803	778,428
Middle	6,135	1,538,307
High	3,484	781,641
Race/Ethnicity		
White	8,365	2,365,595
Black	1,945	369,017
Hispanic/Other	3,636	523,073
School Type		
Public	10,762	2,920,301
Catholic	2,360	222,341
Other Private	842	113,989

a/ In some cases, these numbers do not match those on which the table estimates were based because of missing data. Consequently, approximations of the standard errors associated with the recorded estimates calculated using these numbers may be slightly biased. Exact standard errors of all estimates are available from NCES.

D. Subject Areas Course Categories and Classification of Secondary School Course Codes Used to Define Course-Taking Patterns

The subject areas -- mathematics, science, vocational education, and computer science -- were subdivided for purposes of identifying student course-taking patterns. The secondary school courses which constituted these subdivisions were grouped according to the codes for the Classification of Secondary School Courses (CSSC). The CSSC was originially developed for use in coding transcripts of students participating in the National Center for Education Statistics' longitudinal High School and Beyond study. This nationwide inventory of high school courses identifies each course with a six-digit numerical code. Each subject area and its subdivisions are listed. The appropriate CSSC codes and their titles follow.*

MATHEMATICS

College Preparatory (For Gifted-Talented Students)

27.0417	Linear Algebra
27.0419	Calculus
27.0420	Calculus, Advanced Placement

College Preparatory (For Mathematics Concentrators)

27.0400	Pure Mathematics, Other
27.0412	Analytic Geometry
27.0413	Trigonometry and Solid Geometry
27.0414	Algebra and Trigonometry
27.0415	Algebra and Analytic Geometry
27.0416	Analysis, Introductory
27.0418	Calculus and Analytic Geometry
27.0423	Mathematics 3, Unified
27.0424	Mathematics, Independent Study
27.0500	Statistics, Other
27.0511	Statistics
27.0521	Probability
27.0531	Probability and Statistics

College Preparatory (For 4-Year College Bound)

27.0404	Algebra 1
27.0405	Algebra 2
27.0406	Geometry, Plane
27.0407	Geometry, Solid
27.0408	Geometry
27.0410	Algebra 3
27.0411	Trigonometry
27.0421	Mathematics 1, Unified
27.0422	Mathematics 2, Unified

*Each course is identified with a six-digit numerical code. When all the courses encompassed under a CSSC instructional program are used, only the four-digit code associated with that program is listed.

General

27.0106	Mathematics 1, General
27.0107	Mathematics 2, General
27.0402	Algebra 1, Part 1
27.0403	Algebra 1, Part 2
27.0409	Geometry, Informal

Vocational

01.0151	Agricultural Mathematics
07.0171	Business Mathematics 1
07.0172	Business Mathematics 2
07.0221	Financial Mathematics
17.0651	Nurse's Mathematics
27.0110	Mathematics, Vocational
27.0111	Technical Mathematics
32.0108	Mathematics for Employment

Basic

27.0100	Mathematics, Other General
27.0105	Mathematics, Basic
27.0108	Science Mathematics
27.0114	Consumer Mathematics

Optional

11.0121	Computer Mathematics 1
11.0122	Computer Mathematics 2
27.0109	Mathematics in the Arts
27.0112	Mathematics Review
27.0113	Mathematics Tutoring
27.0200	Actuarial Sciences, Other
27.0300	Applied Mathematics, Other
27.9900	Mathematics, Other

SCIENCE

General Life Sciences

26.0121	Biology, Basic
26.0131	Biology, General
26.0151	Field Biology
26.0751	Physiology, Human

Advanced Life Sciences

26.0141	Biology, College Preparatory
26.0142	Biology, Advanced
26.0161	Genetics
26.0171	Biopsychology
26.0181	Biology Seminar
26.0100	Biology, Other General

26.0711	Zoology
26.0721	Zoology, Vertebrate
26.0731	Zoology, Invertebrate
26.0741	Animal Behavior
26.0752	Physiology, Advanced
26.0761	Pathology
26.0700	Zoology, Other
26.02	Biochemistry and Biophysics
26.03	Botany
26.04	Cell and Molecular Biology
26.05	Microbiology
26.06	Miscellaneous Specialized Areas, Life Sciences
26.99	Life Sciences, Other

General Physical Sciences

40.01	Physical Sciences, General
40.0551	Consumer Chemistry
40.0611	Earth Science

Advanced Physical Sciences

40.02	Astronomy
40.03	Astrophysics
40.04	Atmospheric Science and Meteorology
40.0511	Chemistry, Introductory
40.0521	Chemistry 1
40.0522	Chemistry 2
40.0531	Organic Chemistry
40.0541	Physical Chemistry
40.0561	Chemistry, Independent Study
40.0500	Chemistry, Other
40.0621	Earth Science, College Preparatory
40.0631	Geology
40.0641	Mineralogy
40.0600	Geological Sciences, Other
40.07	Miscellaneous Physical Sciences
40.08	Physics
40.09	Planetary Science
40.99	Physical Sciences, Other

VOCATIONAL EDUCATION

Agriculture

01.01	Agricultural Business and Management
01.02	Agricultural Mechanics
01.03	Agricultural Production (plus 01.0681)
01.04	Agricultural Products and Processing
01.05	Agricultural Services and Supplies
01.06	Horticulture (All except 01.0681) (plus 02.0421 - 02.0423)
01.07	International Agriculture
01.99	Agribusiness and Agriculture Production, Other
02.01	Agricultural Sciences, General
02.02	Animal Sciences
02.03	Food Sciences

Agriculture (Cont'd)

02.04	Plant Sciences (All except 02.0421 - 02.0423)
02.05	Soil Sciences
03.01	Renewable Natural Resources, General
03.02	Conservation and Regulation
03.03	Fishing and Fisheries
03.04	Forestry Production and Processing
03.05	Forestry and Related Sciences
03.06	Wildlife Management
03.99	Renewable Natural Resources, Other

Business

06.01	Business and Management, General
06.02	Accounting
06.04	Business Administration and Management
06.05	Business Economics
06.06	Human Resources Development
06.09	International Business Management
06.11	Labor Industrial Relations
06.12	Management Information Systems
06.13	Management Science
06.15	Organizational Behavior
06.16	Personnel Management
06.18	Small Business Management and Ownership
06.19	Taxation
06.99	Business and Management, Other
07.01	Accounting, Bookkeeping, and Related Programs (All except 07.0161 and 07.0162)
07.02	Banking and Related Financial Programs (plus 06.03)
07.03	Business Data Processing and Related Programs
07.04	Office Supervision and Management (All except 07.0411 and 07.0412)
07.05	Personnel and Training Programs
07.06	Secretarial and Related Programs (plus 07.0411 and 07.0412)
07.07	Typing, General Office, and Related Programs (plus 07.0161 and 07.0162)
07.99	Business and Office, Other

Marketing

06.07	Institutional Management
06.08	Insurance and Risk Management
06.14	Marketing Management and Research
06.17	Real Estate
08.01	Apparel and Accessories Marketing
08.02	Business and Personal Services Marketing
08.03	Entrepreneurship
08.04	Financial Services Marketing
08.05	Floristry, Farm and Garden Supplies Marketing
08.06	Food Marketing
08.07	General Marketing

Marketing (Cont'd)

08.08	Home and Office Products Marketing
08.09	Hospitality and Recreation Marketing
08.10	Insurance Marketing
08.11	Transportation and Travel Marketing
08.12	Vehicles and Petroleum Marketing
08.99	Marketing and Distribution, Other
09.02	Advertising

Health

17.01	Dental Services
17.02	Diagnostic and Treatment Services (All except 17.0211)
17.03	Medical Laboratory Technologies
17.04	Mental Health/Human Services
17.05	Miscellaneous Allied Health Services (All except 17.0561)
17.06	Nurse-Related Services (All except 17.0611)
17.07	Ophthalmic Services
17.08	Rehabilitation Services
17.99	Allied Health, Other

Industrial Arts

21.01	Industrial Arts (All except 21.0110, 21.0111, 21.0112, 21.0114, 21.0116 - 21.0118, 21.0120 - 21.0124)
47.0651	Consumer Auto
48.0511	Metal 1
48.0711	Woodworking 1

Technologies

10.01	Communication Technologies (All except 10.0111 - 10.0132)
11.01	Computer and Information Sciences, General
11.03	Data Processing
11.04	Information Sciences and Systems
11.05	Systems Analysis
11.99	Computer and Information Sciences, Other
15.0400	Electromechanical Instrumentation and Maintenance Technologies, Other
15.0500	Environmental Control Technologies, Other
15.06	Industrial Production Technologies (All except 15.0611 and 16.0631)
15.0700	Quality Control and Safety Technologies, Other
15.0800	Mechanical and Related Technologies, Other
15.0900	Mining and Petroleum Technologies, Other

Trade and Industry

06.20	Trade and Industrial Supervision and Management
12.01	Drycleaning and Laundering Services
12.04	Personal Services
12.99	Consumer, Personal, and Miscellaneous Services, Other
43.01	Criminal Justice
43.02	Fire Protection

Trade and Industry (Cont'd)

43.99	Protective Services, Other
46.01	Brickmasonry, Stonemasonry, and Tile Setting
46.02	Carpentry
46.03	Electrical and Power Transmission Installation (plus 47.0521)
46.04	Miscellaneous Construction Trades (All except 46.0441)
46.05	Plumbing, Pipefitting, and Steamfitting
46.99	Construction Trades, Other
47.01	Electrical and Electronics Equipment Repair (plus 15.05, 21.0114, 21.0116 - 21.0118, 21.0120)
47.02	Heating, Air Conditioning, and Refrigeration Mechanics (plus 15.0511)
47.03	Industrial Equipment Maintenance and Repair (All except 47.0321) (Plus 15.0911 and 15.0921)
47.04	Miscellaneous Mechanics and Repair (Plus 15.0411 and 15.0441)
47.06	Vehicle and Mobile Equipment Mechanics and Repair (All except 47.0651) (Plus 47.0321, 47.0511 - 47.0514)
47.99	Mechanics and Repairers, Other
48.01	Drafting (Plus 15.0211)
48.02	Graphic and Printing Communications (plus 10.0131 and 10.0132)
48.03	Leatherworking and Upholstering (All except 48.0311 and 48.0312)
48.04	Precision Food Production
48.05	Precision Metal Work (All except 48.0511) (plus 15.0611, 15.0711, 21.0121 - 21.0124)
48.06	Precision Work, Assorted Materials (plus 15.0631)
48.07	Woodworking (All except 48.0711)
48.99	Precision Production, Other
49.01	Air Transportation
49.02	Vehicle and Equipment Operation
49.03	Water Transportation
49.99	Transportation and Material Moving, Other
21.0110	Trade and Industry Cooperative
21.0111	Industrial Cooperative Work Experience
21.0112	Industrial Cooperative Work Experience, Advanced
32.0104	Work Experience
32.0105	Work Experience, Advanced
32.0106	Cooperative Education 1
32.0107	Cooperative Education 2

Consumer Home Economics

20.0113	Home Economics 1
20.0114	Home Economics 2
20.0115	Home Economics 3
20.0116	Home Economics 4
20.0118	Comprehensive Consumer and Homemaking Home Economics, Independent Study
20.0122	Child Development 1
20.0123	Child Development 2
20.0124	Child Development 3
20.0125	Child Development 4
20.0133	Clothing 1

Consumer and Home Economics (Cont'd)

20.0134	Clothing 2
20.0135	Clothing 3
20.0136	Clothing 4
20.0137	Tailoring
20.0141	Consumer Education 1
20.0142	Consumer Education 2
12.9900	Consumer, Personal, and Miscellaneous Services, Other
20.0151	Home Economics Occupations 1, Exploratory
20.0152	Home Economics Occupations 2, Exploratory
20.0161	Family Health 1
20.0162	Family Health 2
20.0117	Adults Roles and Functions
17.0211	First Aid
20.0171	Family Relations
20.0172	Marriage Society and Change
20.0173	Parenthood
20.0154	Home Economics Leadership
35.0111	Interpersonal Relationships
35.0121	Building Human Relationships
35.0100	Interpersonal Skills, Other
37.0111	Personal Development Techniques
37.0121	Coping with Personal Problems
37.0131	Self Perception
37.0100	Personal Awareness, Other
20.0183	Foods 1
20.0184	Foods 2
20.0185	Foods 3
20.0186	Foods 4
20.0187	International Foods
20.0188	Nutrition
19.0500	Food Sciences and Human Nutrition, Other
20.0191	Home Management 1
20.0192	Home Management 2
19.0400	Family/Consumer Resource Management, Other
45.0441	Home Maintenance and Repair
19.06	Human Environment and Housing
04.0511	Interior Design
04.0500	Interior Design, Other
20.0100	Consumer and Home Economics

Occupational Home Economics

20.0211	Child Care Services
20.0221	Child Care Aide
42.0711	Child Psychology
20.0231	Child Care Management
20.0241	Foster Care and Family Care
20.0251	Teacher Aide
20.0153	Home Economics Laboratory Assistant
33.0111	Student Assistant
20.0321	Clothing Maintenance Aide
12.0100	Dry Cleaning and Laundering Services, Other
12.0111	Dry Cleaning
20.0311	Clothing Occupations 1
20.0312	Clothing Occupations 2

Occupational Home Economics (Cont'd)

20.0313	Clothing Occupations 3
20.0331	Commercial Garment and Apparel Construction
20.0391	Clothing Production Management
20.0341	Customer Apparel Construction
20.0351	Customer Tailoring and Alteration
20.0361	Wedding and Specialty Consulting
20.0371	Fashion and Fabric Coordination
20.0381	Textiles Testing
20.0300	Clothing, Apparel, and Textiles, Management, Production, and Services, Other
20.0411	Food Service Training 1
20.0412	Food Service Training 2
20.0421	Food Service Cooperative Training
20.0431	Baking
20.0441	Chef
20.0461	Dietetic Aide
20.0451	Catering
20.0471	Food Testing
20.0481	School Food Service
20.0511	Housing and Interior Design 1
20.0512	Housing and Interior Design 2
20.0513	Interior Design Occupations
20.0521	Floral Design
20.0541	Home Furnishings Aide
20.0551	Custom Drapery and Window Treatment Design
20.0561	Custom Slipcovering and Upholstering
20.0571	Home-Service Assisting
20.0611	Custodial Services
20.0621	Executive Housekeeping
20.0631	Homemaker's Aide
20.0661	Therapeutic Recreation Aide
20.0651	Consumer Aide
20.0641	Companion to the Aged

COMPUTER SCIENCE

Computer Science Languages and Programming

11.0111	Computer Appreciation
11.9900	Computer and Information Sciences, Other
11.0121	Computer Mathematics 1
11.0211	Computer Programming 1
11.0100	Computer and Information Sciences, Other General
11.0241	BASIC Introduction
11.0122	Computer Mathematics 2
11.0212	Computer Programming 2
11.0131	Computer Applications
11.0132	Computer Applications, Independent Study
11.0141	Computer Science, A.P.
11.0221	FORTRAN
11.0231	PASCAL
11.0200	Computer Programming, Other
11.0251	COBOL

Business Data Processing Applications

11.0311	Data Processing 1
07.0311	Computers In Business
07.0321	Business Data Processing 1
07.0331	Business Computer Programming 1
11.0312	Data Processing 2
11.0313	Data Processing Advanced
07.0322	Business Data Processing 2
07.0332	Business Computer Programming 2

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